Pivotal

PRODUCT DOCUMENTATION

Spring Cloud Services for PCF Documentation

Version 1.1

Published: 5 Nov 2018

Rev: 01

Spring Cloud® Services for Pivotal Cloud Foundry

What Is Spring Cloud Services?

The rise in popularity of cloud-native architectures and the shift to implementing applications as series of focused microservices developed around bounded contexts has led to the discovery and rediscovery of patterns useful in designing distributed systems. Techniques such as service discovery, centralized configuration accessed through an application's deployment environment, and graceful degradation of behavior through circuit breakers are common solutions for this style of architecture and can be built into tools for applying these techniques across applications.

Netflix, a pioneer in the microservices space, has built many such tools. Eureka is a service registry, which registers all of a microservice's instances and supplies each microservice with instance information to use in discovering others. Hystrix, the Hystrix Dashboard, and Turbine provide fault tolerance using circuit breakers and enable monitoring of circuits across microservices and instances. These components have been battle-tested in a production environment facing some of the most demanding traffic requirements in the world, and are available as open-source software.

The Spring Cloud family of projects are based on Spring Boot and provide tools including Netflix's Eureka and Hystrix as libraries easily consumable by Spring applications, following idiomatic Spring conventions. Spring Cloud Netflix makes the use of Eureka and Hystrix as simple as including starters dependencies in an application and adding an annotation to a configuration class. Spring Cloud Config includes a configuration server and client library that enable Spring applications to consume centralized configuration as series of property sources.

Spring Cloud Services for Pivotal Cloud Foundry (PCF) packages server-side components of Spring Cloud projects, including Spring Cloud Netflix and Spring Cloud Config, and makes them available as services in the PCF Marketplace. This frees you from having to implement and maintain your own managed services in order to use the included projects. You can create a Config Server, Service Registry, or Circuit Breaker Dashboard service instance on-demand, bind to it and consume its functionality, and return to focusing on the value added by your own microservices.

Services

Spring Cloud Services currently provides the following services.

Service Type	Current Version
Config Server	3
Service Registry	3
Circuit Breaker Dashboard	3

See below for the Spring Cloud Services releases that include each service version.

Service Version	Tile Version
1	1.0.0 - 1.0.3
2	>= 1.0.4 & < 1.1.0
3	1.1.x

Dependencies

Spring Cloud Services relies on the following other Pivotal Cloud Foundry products.

Service	Supported Versions
MySQL	1.6.1-1.7.x
RabbitMQ	1.5.0-1.6.x

Product Snapshot

Current Spring Cloud Services for PCF Details

- **Version**: 1.1.34
- **Release Date**: 27 June 2018
- **Software component version**: Spring Cloud OSS Brixton.SR1
- **Compatible Ops Manager Version(s)**: 1.8.x, 1.7.x, 1.6.x
- **Compatible Elastic Runtime Version(s)**: 1.8.x, 1.7.x, 1.6.x
- **vSphere support?** Yes
- **AWS support?** Yes

Prerequisites to Installing Spring Cloud® Services for Pivotal Cloud Foundry

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Please ensure that your Pivotal Cloud Foundry (PCF) installation meets the below requirements before installing Spring Cloud Services.

Platform and Product Requirements

Important: Spring Cloud Services is currently supported on PCF versions 1.6 and 1.7, but does not support networks configured with multiple subnets. To install Spring Cloud Services, you must configure PCF networks to have only one subnet.

Spring Cloud Services is compatible with the Java buildpack at the version shipped with Pivotal Cloud Foundry® Elastic Runtime or later. At minimum, Spring Cloud Services requires version 2.5 or later of the Java buildpack; it is recommended that you use the latest buildpack version possible. You can use the Cloud Foundry Command Line Interface tool (cf CLI) to see the version of the Java buildpack that is currently installed.

```
$ cf buildpacks
Getting buildpacks...

buildpack               position   enabled   locked   filename
java_buildpack_offline  1          true      false    java-buildpack-offline-v3.5.1.zip
ruby_buildpack          2          true      false    ruby_buildpack-cached-v1.6.8.zip
nodejs_buildpack        3          true      false    nodejs_buildpack-cached-v1.5.2.zip
go_buildpack            4          true      false    go_buildpack-cached-v1.6.3.zip
```

If the default Java buildpack is older than version 2.5, you can download a newer version from Pivotal Network and update Pivotal Cloud Foundry by following the instructions in the Adding Buildpacks to Cloud Foundry topic. To ensure that the newer buildpack is the default Java buildpack, you may delete or disable the older buildpack or make sure that the newer buildpack is in a lower position.

If the default Java buildpack on the Pivotal Cloud Foundry platform is not at version 2.5 or later, you must specify an alternate buildpack that is at version 2.5 or later when installing the Spring Cloud Services product; see step 4 of the Installation topic.

Spring Cloud Services also requires the following Pivotal Cloud Foundry products:

- MySQL
- RabbitMQ

If they are not already installed, you can follow the steps listed in the Installation topic to install them along with Spring Cloud Services.

Important: If you enable the RabbitMQ® for Pivotal Cloud Foundry product's SSL support by providing it with SSL keys and certificates, you must enable the RabbitMQ product's TLS 1.0 support; otherwise, the Spring Cloud Services service broker will fail to create or update service instances. See the Configuring the RabbitMQ Service topic in the RabbitMQ for Pivotal Cloud Foundry documentation.

Security Requirements

You will need to update your Elastic Runtime SSL certificate as described in the Pivotal Cloud Foundry documentation. Generate one single certificate that includes all of the domains listed below, replacing `SYSTEM_DOMAIN.TLD` with your system domain and `APPLICATION_DOMAIN.TLD` with your application domain:

- `*.SYSTEM_DOMAIN.TLD`
- `*.APPLICATION_DOMAIN.TLD`
- `*.login.SYSTEM_DOMAIN.TLD`
- `*.uaa.SYSTEM_DOMAIN.TLD`

If any of these domains are not attributed to your Elastic Runtime SSL certificate, the installation of Spring Cloud Services will fail, and the installation logs will contain an error message that lists the missing domain entries:

```
Missing certs: *.uaa.example.com - exiting install. Please refer to the Security
Requirements section of the Spring Cloud Services prerequisites documentation.
```

Self-Signed Certificates and Internal CAs

If your Pivotal Cloud Foundry installation is using its own self-signed SSL certificate, you must enable the "Ignore SSL certificate verification" or "Disable SSL certificate verification for this environment" option in the **Networking** section of the Pivotal Elastic Runtime tile **Settings** tab. See "Configuring Elastic Runtime for vSphere and vCloud" in the Pivotal Cloud Foundry documentation (PCF 1.6, PCF 1.7).

If you are using an SSL certificate signed by an internal root Certificate Authority (CA), you must use a custom Java buildpack whose keystore contains the internal root CA. Follow the below steps to create and add the custom buildpack.

1. Create a fork of the Cloud Foundry Java buildpack.
2. Add your `cacerts` file to `resources/open_jdk_jre/lib/security/cacerts`.
3. Following the instructions in the "Adding Buildpacks to Cloud Foundry" topic (PCF 1.6, PCF 1.7), add your custom buildpack to Pivotal Cloud Foundry.
4. Using the cf CLI as discussed in the Platform and Product Requirements section above, verify that the custom buildpack is now the default Java buildpack.

Installing Spring Cloud® Services for Pivotal Cloud Foundry

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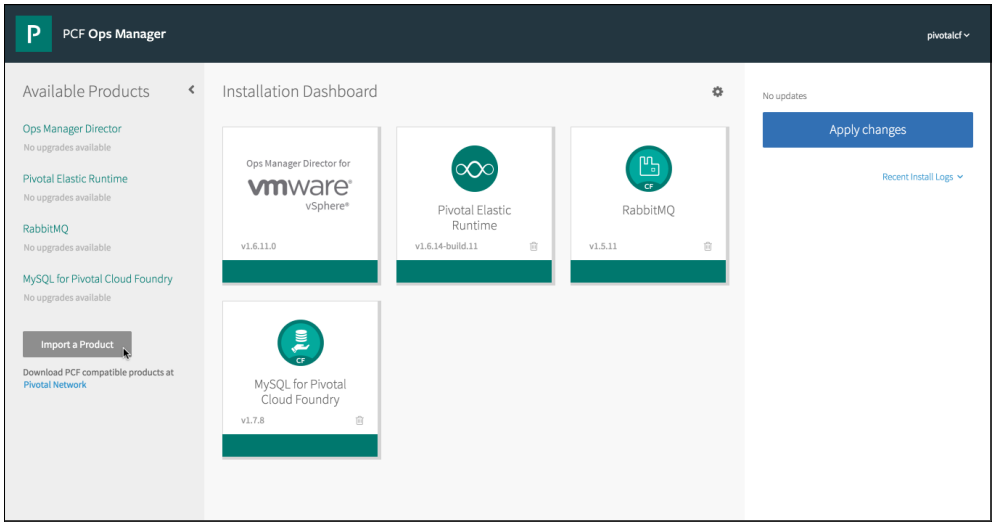
Make sure that you have or have completed all products and requirements listed in the Prerequisites topic. Then follow the below steps to install Spring Cloud Services.

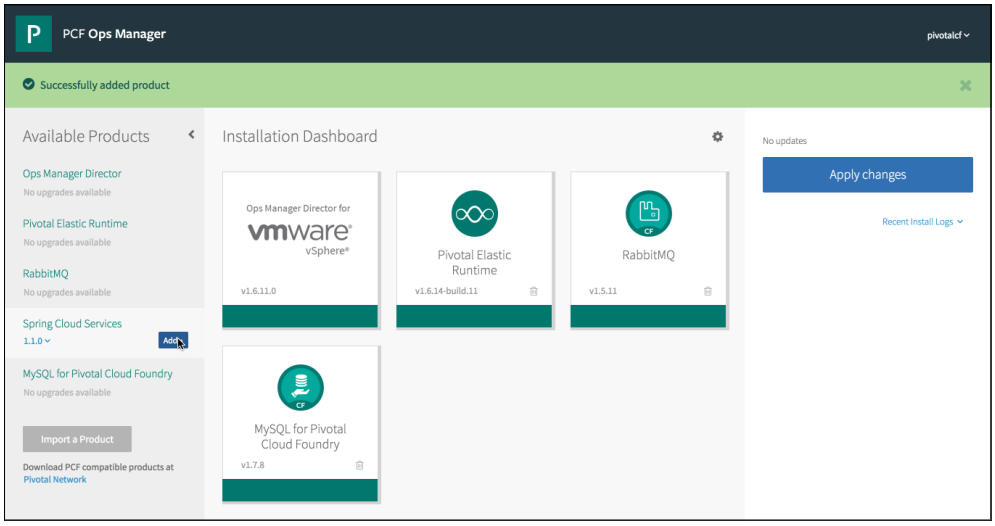
Installation Steps

1. Download Spring Cloud Services from Pivotal Network.

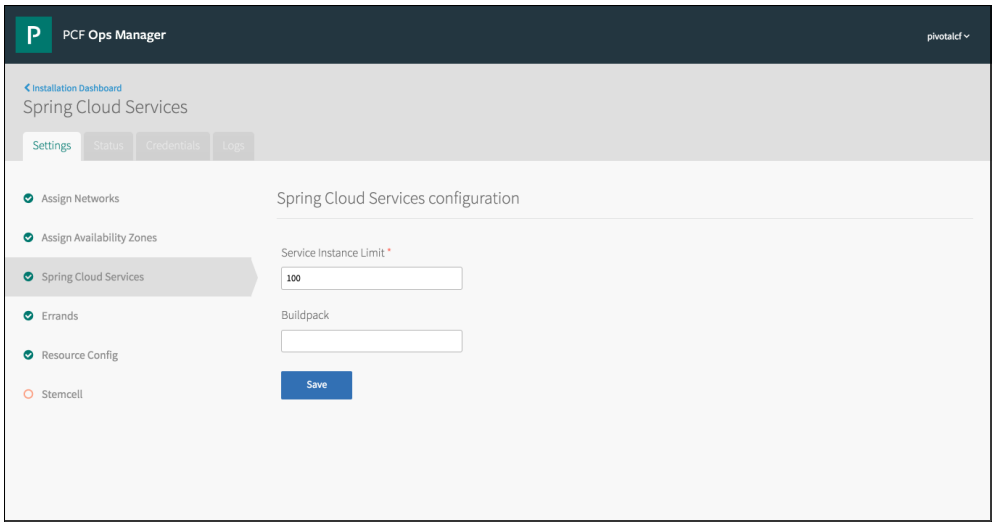
2. In the Installation Dashboard of Pivotal Cloud Foundry (PCF) Operations Manager, click **Import a Product** on the left sidebar to upload the Spring Cloud Services `.pivotal` file.



3. Hover over **Spring Cloud Services** in the **Available Products** list and click the **Add** » button.

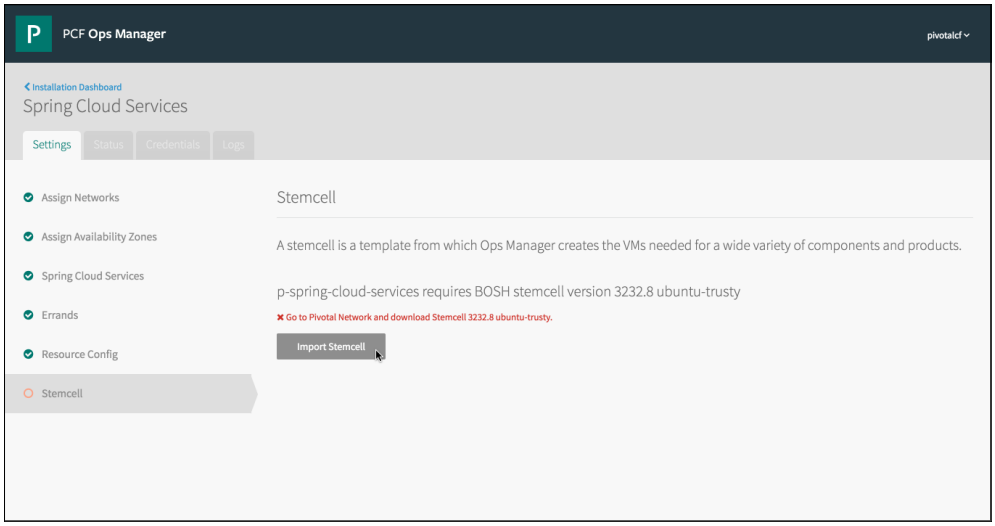


4. When the **Spring Cloud Services** tile appears in the **Installation Dashboard**, click it. In the **Settings** tab, click **Spring Cloud Services** to configure settings for Spring Cloud Services.

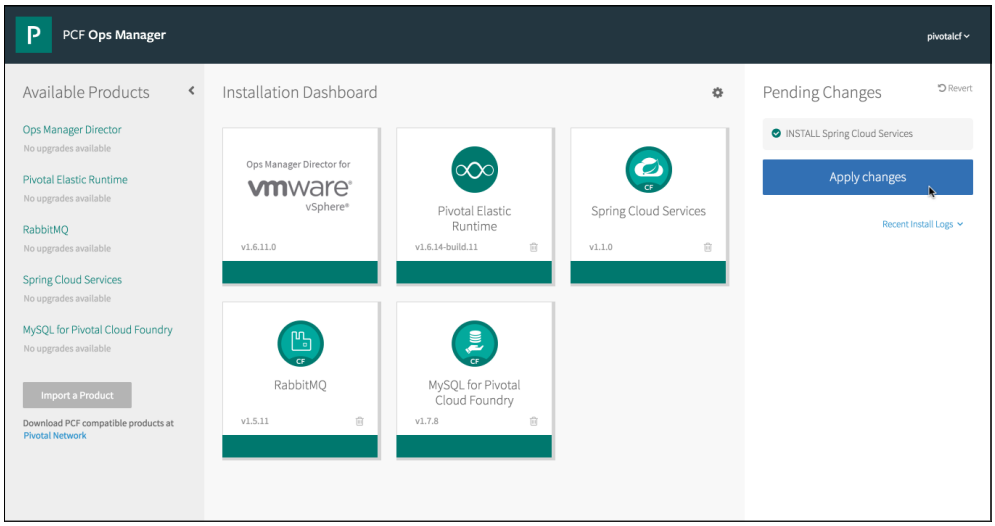


The **Service Instance Limit** setting sets the maximum number of service instances that the Spring Cloud Services service broker will allow to be provisioned (the default value is 100). This setting's value is also used to determine the memory quota for the org in which service instances are deployed; that org's quota will be equal to 1.5G times the configured service instance limit. The **Buildpack** setting is the name of the Java buildpack that the Spring Cloud Services service broker will use to provision service instances (if this setting is left empty, the broker will use the default Java buildpack to provision service instances).

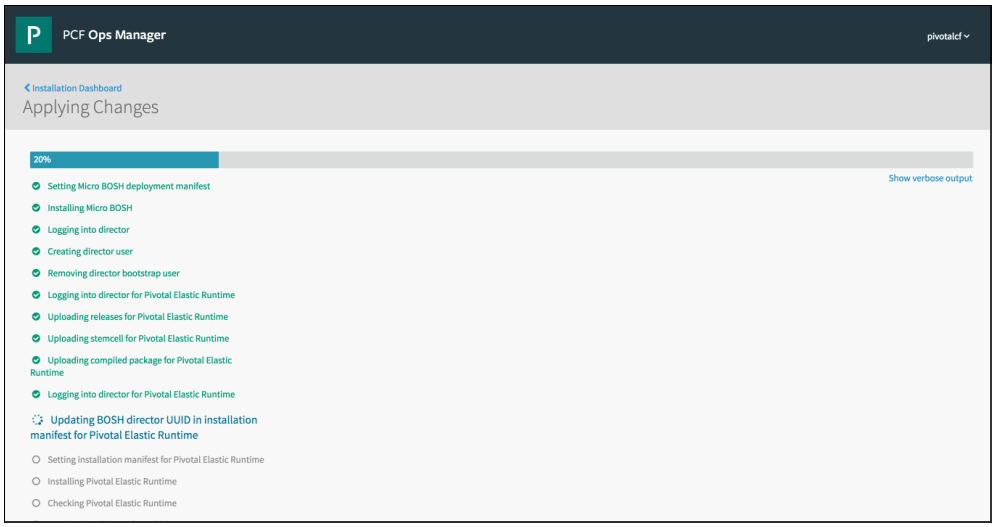
5. If the **Stemcell** tab is highlighted in orange, click it. Download the correct stemcell from Pivotal Network and click **Import Stemcell** to import it.



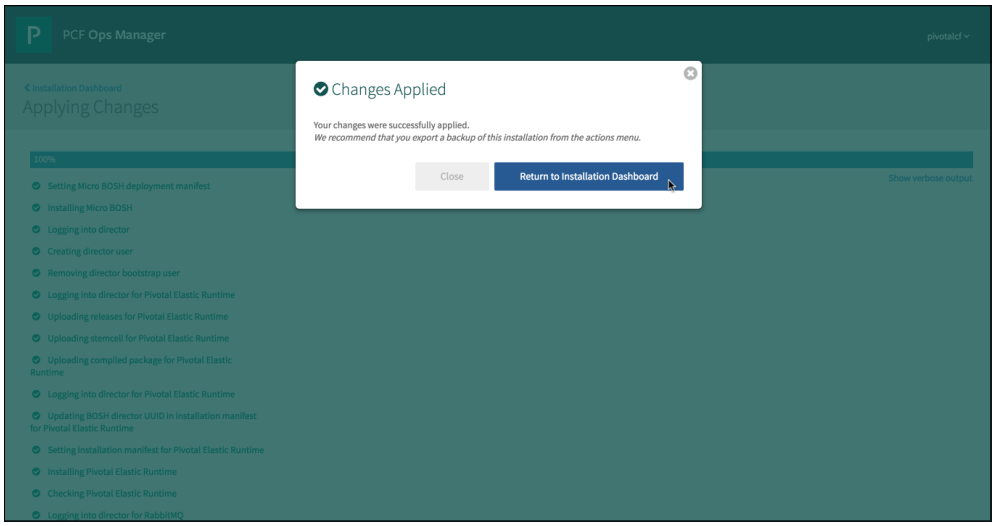
6. Return to the Installation Dashboard and start the installation process by clicking **Apply changes** on the right sidebar.



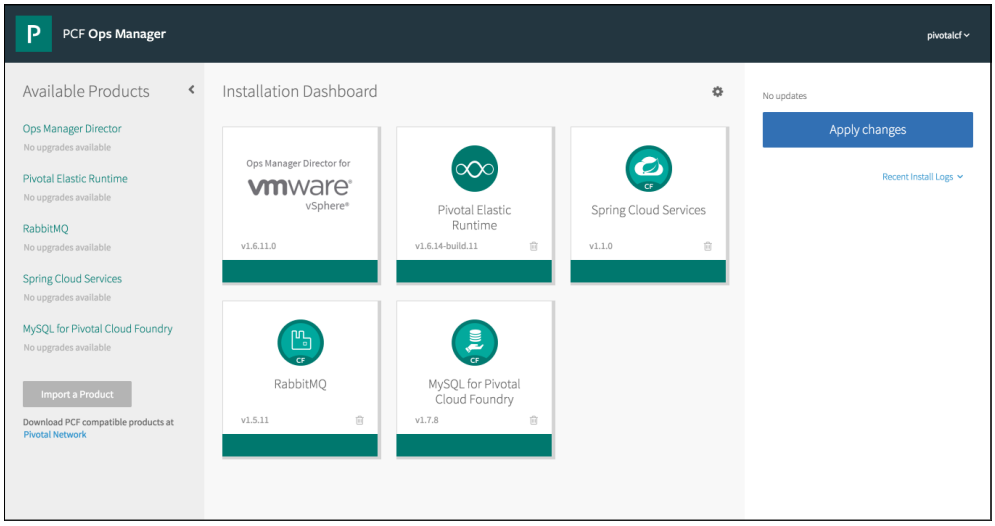
7. The installation process may take 20 to 30 minutes.



8. When the installation process is complete, you will see the dialog shown below. Click **Return to Installation Dashboard**.



9. Congratulations! You have successfully installed Spring Cloud Services.



Upgrading Spring Cloud® Services for Pivotal Cloud Foundry

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Product Upgradeability

Please see the relevant section below for important information regarding upgrades of the Spring Cloud Services product on your version of Pivotal Cloud Foundry.

Upgrades on Pivotal Cloud Foundry 1.6

When upgrading to a patch version of the Spring Cloud Services (SCS) product on Pivotal Cloud Foundry 1.6, you must consecutively apply all patch versions between your currently-installed SCS version and the version to which you wish to upgrade, and you may not skip a patch version. For example, you may not upgrade SCS 1.0.6 directly to SCS 1.0.8; instead, to upgrade SCS 1.0.6 to SCS 1.0.8, you must upgrade SCS 1.0.6 to SCS 1.0.7, then upgrade SCS 1.0.7 to SCS 1.0.8.

Upgrades on Pivotal Cloud Foundry 1.7

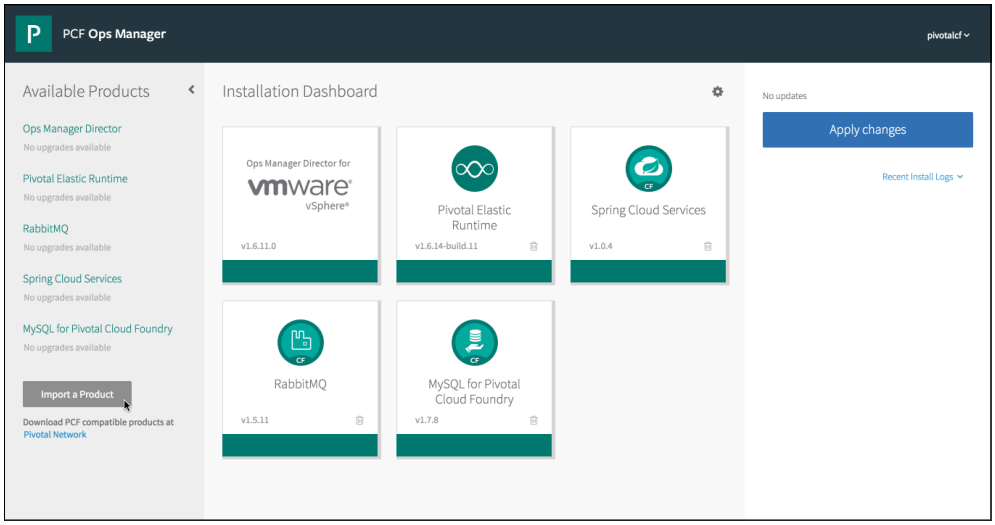
On Pivotal Cloud Foundry 1.7, you may not upgrade any version of the Spring Cloud Services product between 1.0.0 and 1.0.8 to any version older than 1.0.9 (e.g., you may not upgrade SCS 1.0.1 to SCS 1.0.2); however, you may upgrade any of these versions directly to 1.0.9 or later. You may upgrade any patch version of SCS after 1.0.9 directly to any later patch version and need not apply any intervening patch versions.

Product Upgrade Steps

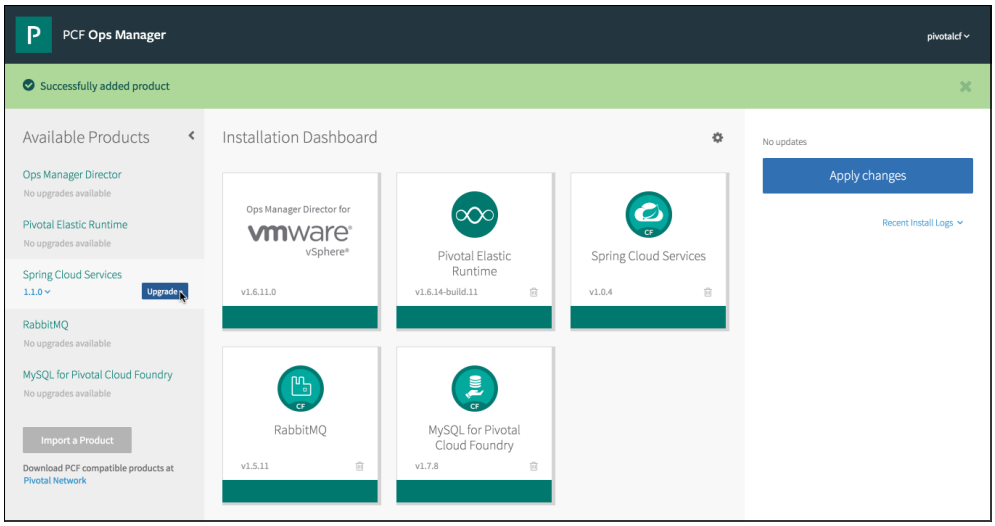
Follow the below steps to upgrade the Spring Cloud Services product.

1. Download the latest version of Spring Cloud Services from Pivotal Network.

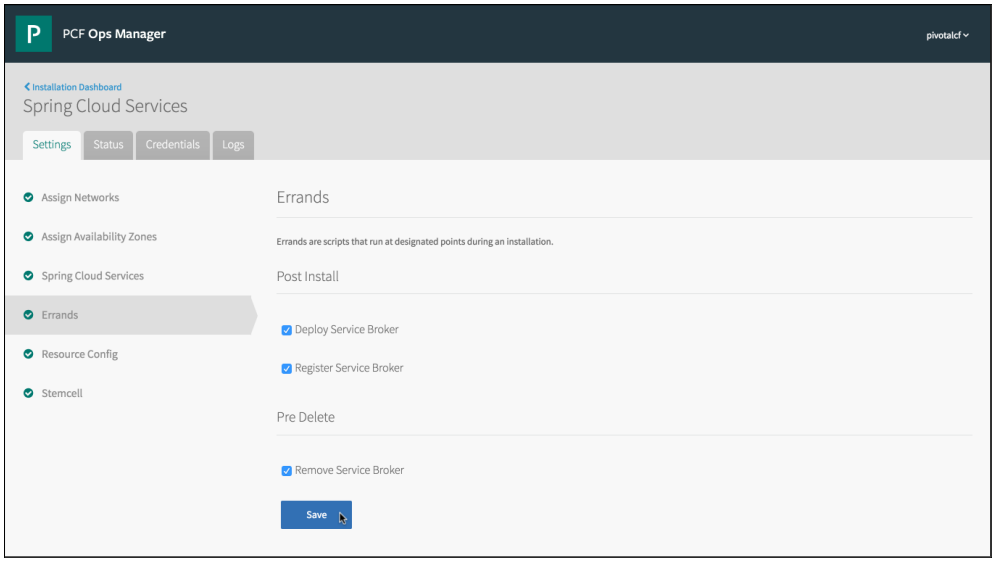
2. In the Installation Dashboard of Pivotal Cloud Foundry (PCF) Operations Manager, click **Import a Product** on the left sidebar to upload the `p-spring-cloud-services-<version>.pivotal` file.



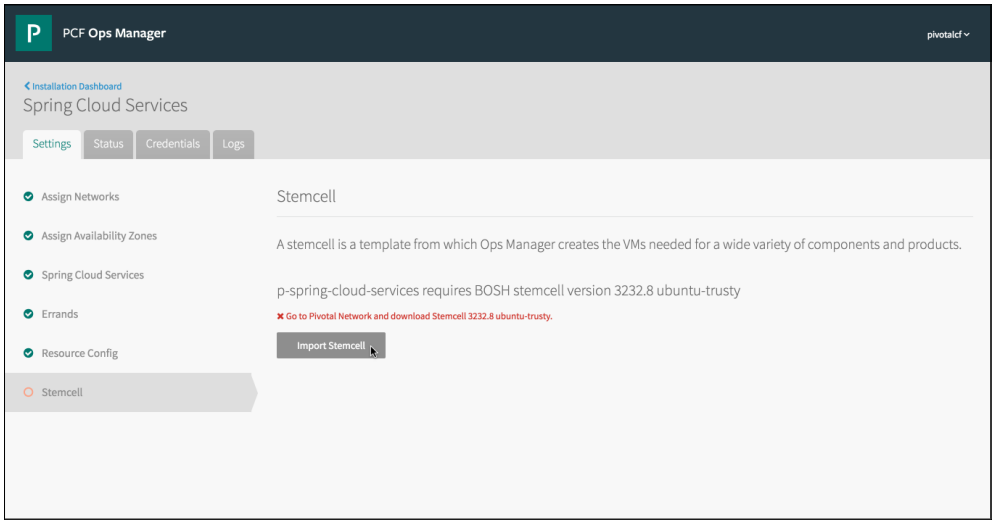
3. After uploading the file, hover over **Spring Cloud Services** in the **Available Products** list and click the **Upgrade »** button.



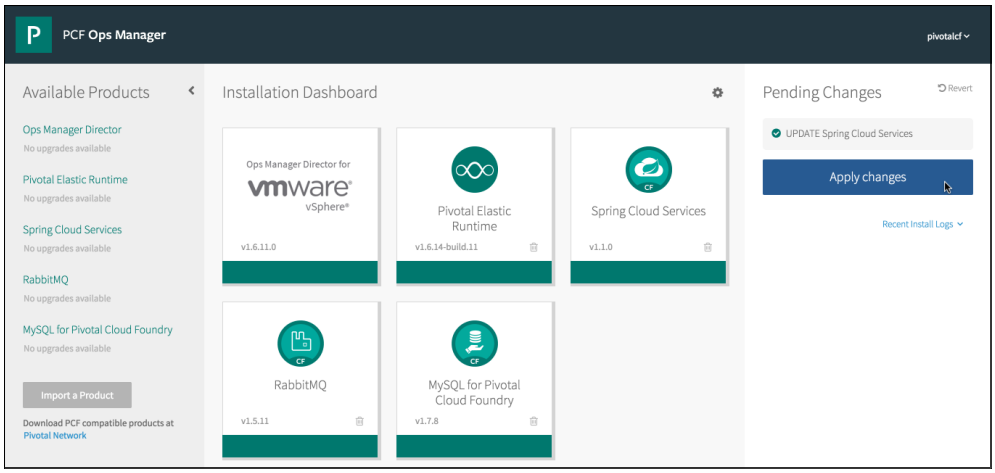
4. Click the Spring Cloud Services tile. In the **Errands** tab, ensure that all of the Spring Cloud Services errands are enabled.



5. If the **Stemcell** tab is highlighted in orange, click it. Then click **Import Stemcell** to import the correct stemcell.

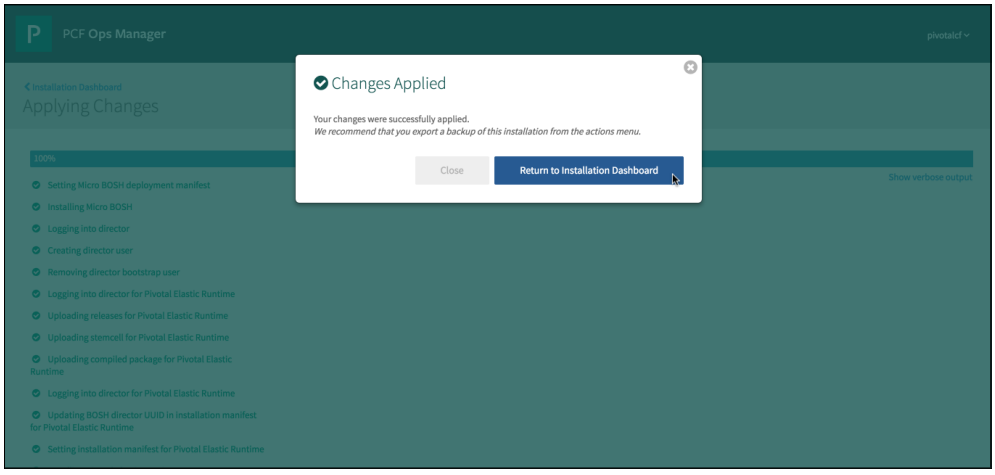


6. In the Installation Dashboard, click **Apply changes** on the right sidebar.

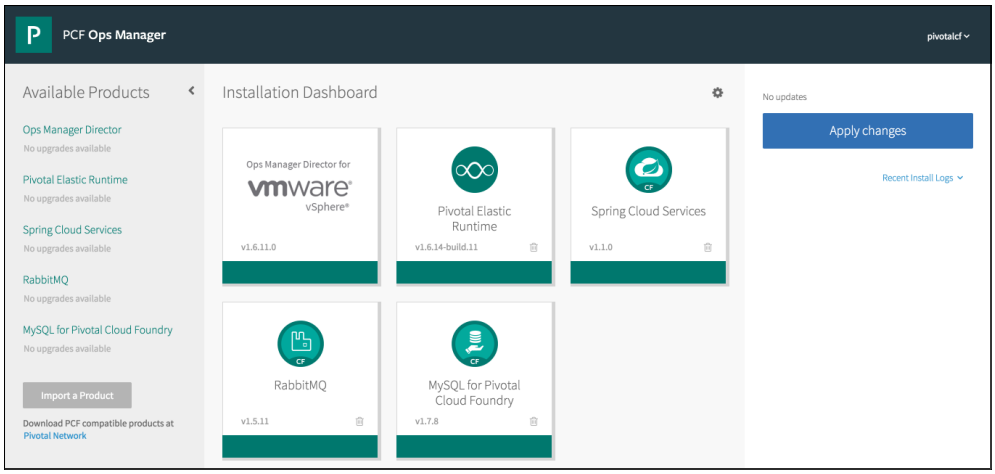


7. The upgrade process may take 20 to 30 minutes.

8. When the upgrade process is complete, you will see the dialog shown below. Click **Return to Installation Dashboard**.



9. Congratulations! You have successfully upgraded Spring Cloud Services.



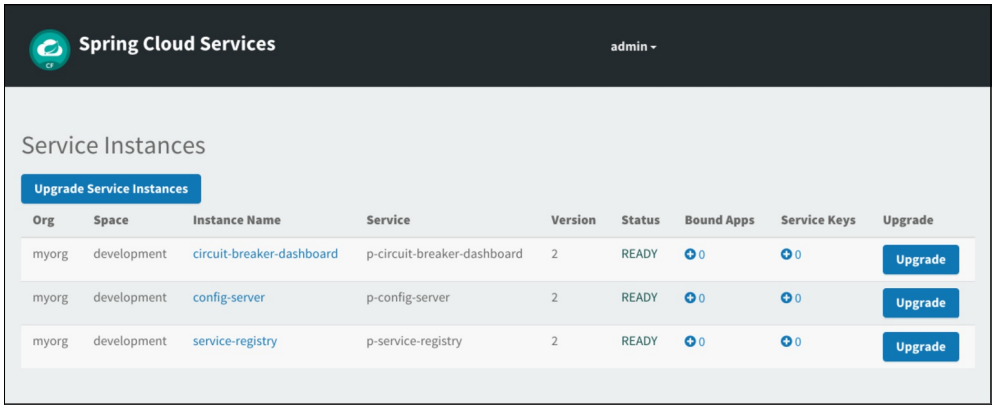
Service Instance Upgrade Steps

After upgrading the Spring Cloud Services product, you can follow the below steps to upgrade an individual service instance or to upgrade all service instances. You can also use the Cloud Foundry Command Line Interface tool (cf CLI) to upgrade an individual service instance; see the Service Instance Upgrades topic for more information.

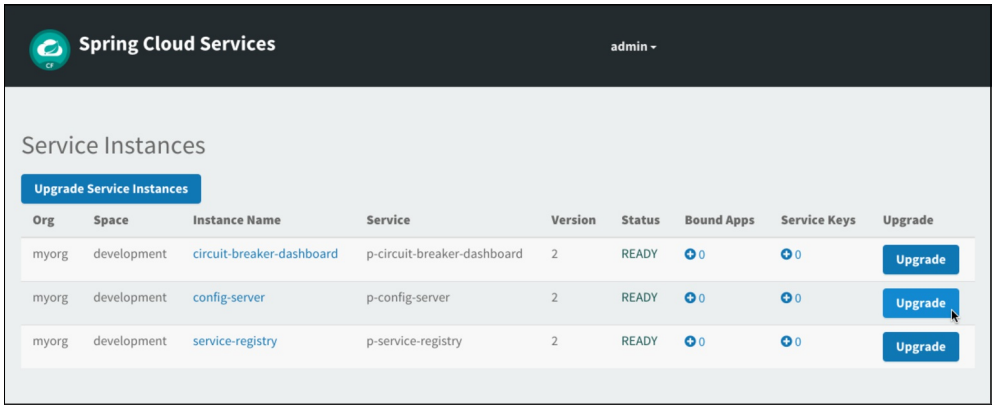
Important: If you have client applications which work with Spring Cloud Services 1.0.x service instances and are upgrading these service instances to 1.1.x, you must update your client applications to use the current version of the Spring Cloud Services client dependencies. See the Client Application Changes in 1.1.0 section of the Service Instance Upgrades topic.

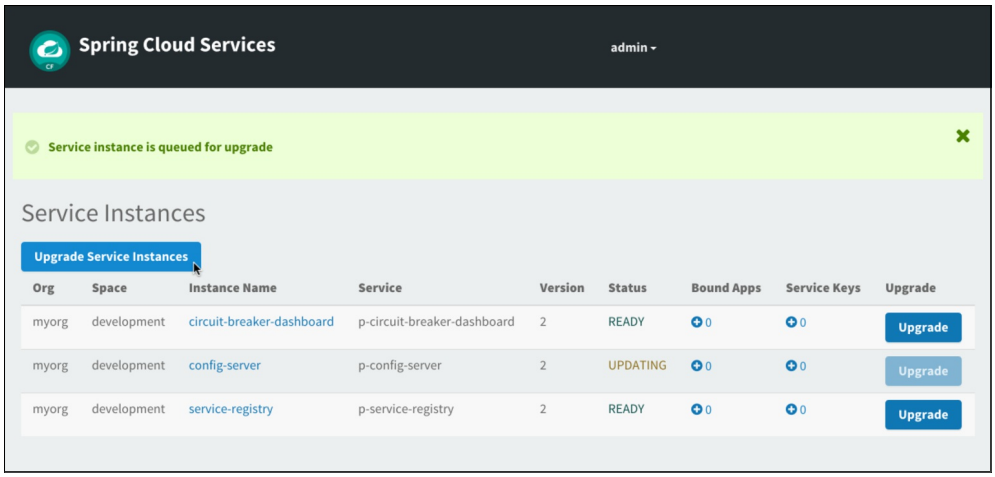
Important: After upgrading a Circuit Breaker Dashboard service instance from 1.0.x to 1.1.x, you must unbind, rebind, and restart any client applications which were bound to the instance. This is due to a change in how service instance credentials are managed.

1. To see the current version of a service instance, visit the Service Instances dashboard. (See the Service Instances Dashboard section of the Operator Information topic.)

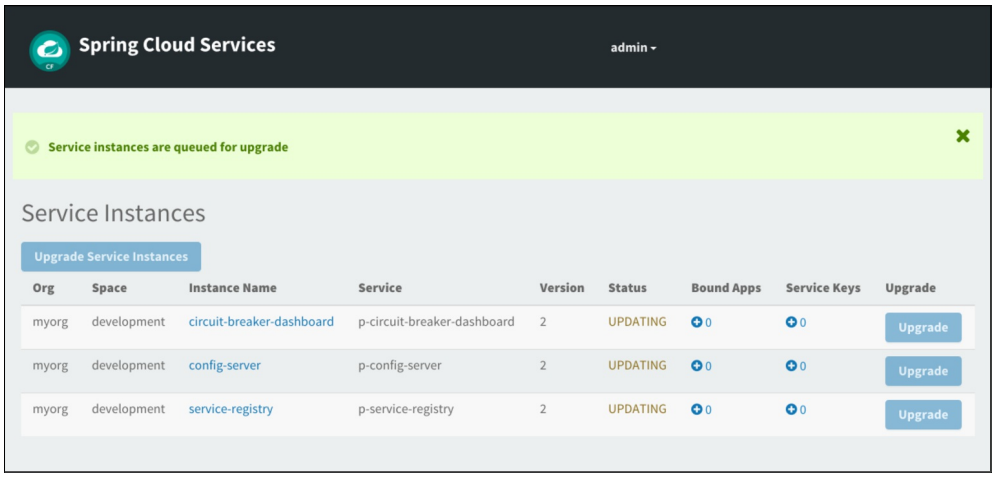


2. Click **Upgrade** in the listing for the service instance. To upgrade all service instances which are not at the versions included in the currently-installed Spring Cloud Services product, you may also click **Upgrade Service Instances**.

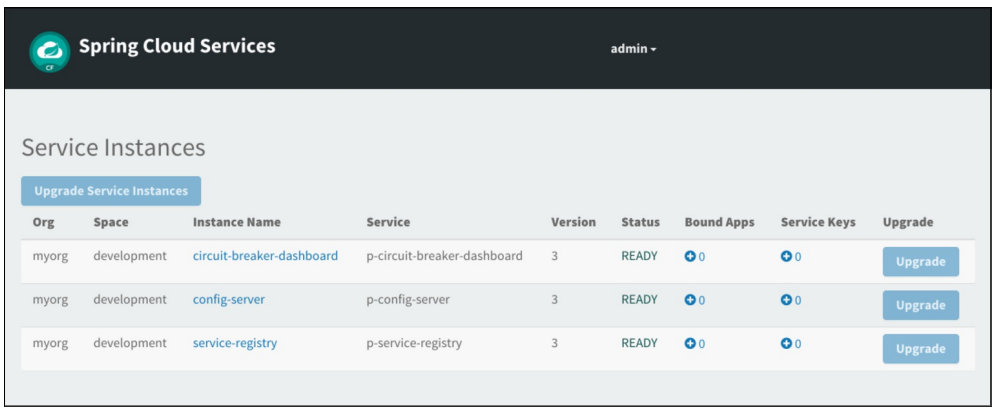




3. Wait while any backing applications belonging to the service instance or instances are upgraded. The dashboard will show the `UPDATING` status for an instance while it is being upgraded.



4. When the service instances have been upgraded, the dashboard will show the new versions.



Troubleshooting Spring Cloud® Services for Pivotal Cloud Foundry

See below for information about problems related to your Pivotal Cloud Foundry (PCF) platform configuration or Spring Cloud Services or other product installation.

"No subject alternative DNS name matching p-spring-cloud-services.uaa.example.com found"

If you encounter an exception message similar to the following:

```
org.springframework.web.client.ResourceAccessException: I/O error on POST request for
"https://p-spring-cloud-services.uaa.example.com/oauth/token":
java.security.cert.CertificateException: No subject alternative DNS name matching
p-spring-cloud-services.uaa.example.com found.; nested exception is
javax.net.ssl.SSLHandshakeException: java.security.cert.CertificateException: No
subject alternative DNS name matching p-spring-cloud-services.uaa.example.com found.
```

Ensure that your PCF installation meets the requirements described in the Security Requirements section of the Prerequisites topic. Be sure that your Elastic Runtime SSL certificate includes all wildcards listed in that section and has a separate wildcard for each subdomain.

"javax.net.ssl.SSLException: Received fatal alert: protocol_version"

The Cloud Foundry Command Line Interface tool (cf CLI) `create-service` command may return an error similar to the following:

```
Server error, status code: 502, error code: 10001, message: Service broker error:
javax.net.ssl.SSLException: Received fatal alert: protocol_version
```

Spring Cloud Services requires the RabbitMQ for PCF product. If you have provided SSL certificates and keys to RabbitMQ for PCF, you must also enable its TLS 1.0 support in order to use it with Spring Cloud Services. See the note at the end of the Platform and Product Requirements section of the Prerequisites topic.

"com.rabbitmq.client.AuthenticationFailureException: ACCESS_REFUSED - Login was refused using authentication mechanism PLAIN"

If you encounter the following exception message in Spring Cloud Services broker logs:

```
org.springframework.amqp.AmqpAuthenticationException:
com.rabbitmq.client.AuthenticationFailureException: ACCESS_REFUSED - Login was
refused using authentication mechanism PLAIN. For details see the broker
logfile.
```

The credentials used by the Spring Cloud Services broker to access its RabbitMQ for PCF service instance may be invalid. This can happen after restoring a backup of Pivotal Cloud Foundry® Elastic Runtime, as a restored RabbitMQ for PCF service instance may not accept the restored credentials used by the Spring Cloud Services broker. You can update the Spring Cloud Services broker's credentials by unbinding the RabbitMQ service instance from the broker applications (the `spring-cloud-broker` and `spring-cloud-broker-worker` applications) and then rebinding.

To unbind the RabbitMQ service instance from the Spring Cloud Services broker applications and rebind it, run the following cf CLI commands:

```
$ cf target -o system -s p-spring-cloud-services
$ cf unbind-service spring-cloud-broker spring-cloud-broker-rmq
$ cf unbind-service spring-cloud-broker-worker spring-cloud-broker-rmq
$ cf bind-service spring-cloud-broker spring-cloud-broker-rmq
$ cf restage spring-cloud-broker
$ cf bind-service spring-cloud-broker-worker spring-cloud-broker-rmq
$ cf restage spring-cloud-broker-worker
```

If the PCF environment is newly restored and the RabbitMQ service instance's queues are empty, you may also unbind the RabbitMQ service instance from the broker applications, delete it, create a new instance, and then bind that instance to the Spring Cloud Services broker applications.

WARNING: Deleting and replacing the RabbitMQ service instance will destroy the original instance's virtual host and any data in the instance's queues. If the RabbitMQ service instance contains messages and is on a production system, unbind and rebind it instead.

To delete and replace the RabbitMQ service instance used by the Spring Cloud Services broker applications, run the following cf CLI commands:

```
$ cf target -o system -s p-spring-cloud-services
$ cf unbind-service spring-cloud-broker spring-cloud-broker-rmq
$ cf unbind-service spring-cloud-broker-worker spring-cloud-broker-rmq
$ cf delete-service -f spring-cloud-broker-rmq
$ cf create-service p-rabbitmq standard spring-cloud-broker-rmq
$ cf bind-service spring-cloud-broker spring-cloud-broker-rmq
$ cf restage spring-cloud-broker
$ cf bind-service spring-cloud-broker-worker spring-cloud-broker-rmq
$ cf restage spring-cloud-broker-worker
```

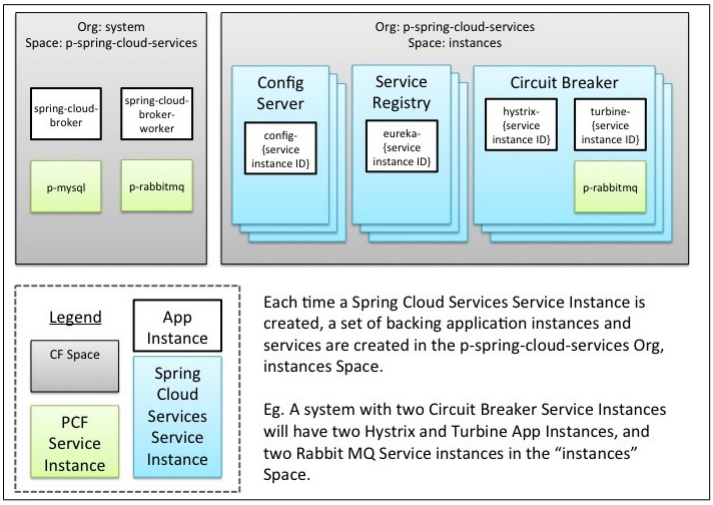
Operator Information

Page last updated:

See below for information about Spring Cloud® Services' deployment model and other information which may be useful in operating its services or client applications.

Service Orchestration

Spring Cloud Services provides a series of Managed Services on Pivotal Cloud Foundry (PCF). It uses Cloud Foundry's Service Broker API to manage the three services—Config Server, Service Registry, and Circuit Breaker Dashboard—that it makes available. See below for information about Spring Cloud Services's broker implementation.



The Service Broker

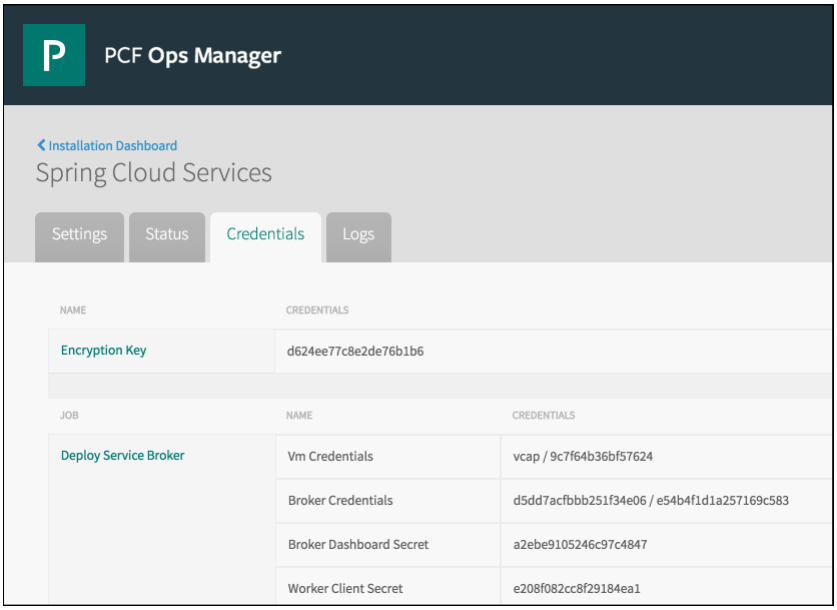
The service broker's functionality is divided between the following two Spring Boot applications, which are deployed in the "system" org to the "p-spring-cloud-services" space.

- spring-cloud-broker ("the SB"): Implements the Service Broker API.
- spring-cloud-broker-worker ("the Worker"): Acts on provision, deprovision, bind, and unbind requests.

The broker relies on two other Pivotal Cloud Foundry products, MySQL for Pivotal Cloud Foundry and RabbitMQ® for Pivotal Cloud Foundry, for the following service instances.

- **spring-cloud-broker-db**: A MySQL database used by the SB.
- **spring-cloud-broker-rmq**: A RabbitMQ queue used for communication between the SB and the Worker.

You can obtain the broker username and password from the Spring Cloud Services tile in Pivotal Cloud Foundry® Operations Manager. Click the Spring Cloud Services tile, and in the **Credentials** tab, copy the Broker Credentials.



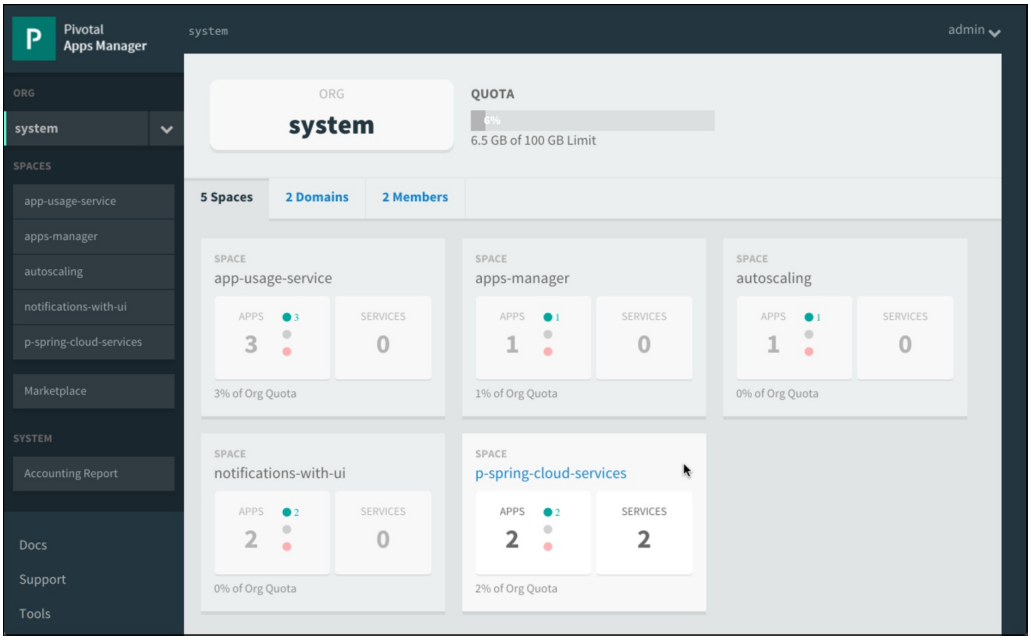
Broker Upgrades

The Spring Cloud Services product upgrade process checks before redeploying the service broker to see whether the broker applications' version has changed. If the version has not changed, the upgrade process will continue without redeploying either the SB or the Worker.

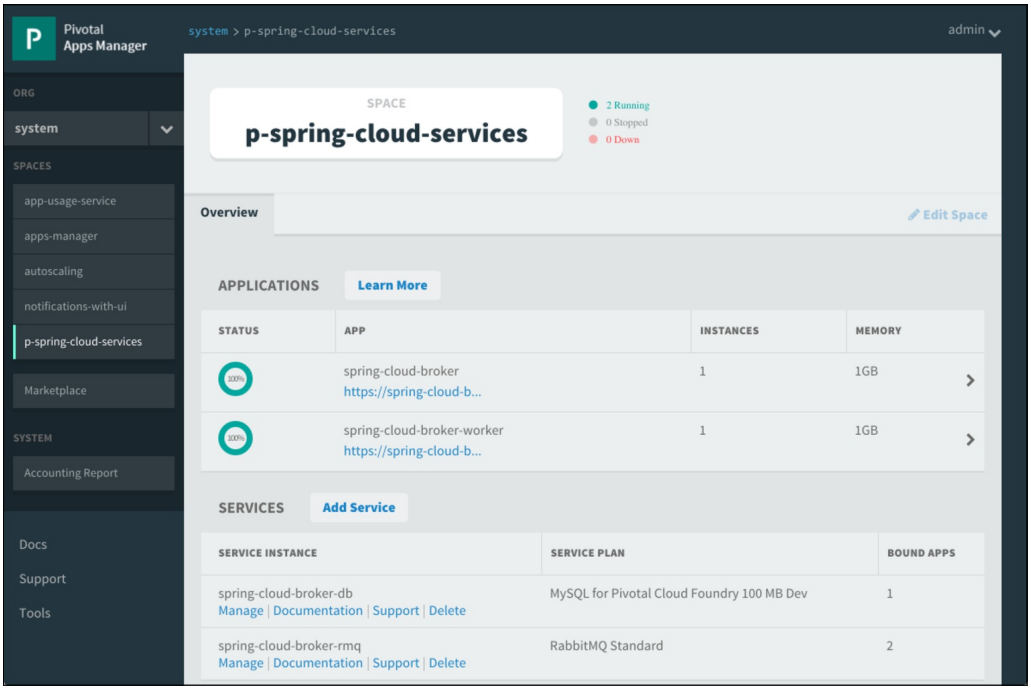
The SB application and the Worker application are deployed using a blue-green deployment strategy. During an upgrade of the service broker, the broker will continue processing requests to provision, deprovision, bind, and unbind service instances, without downtime.

Access Broker Applications in Apps Manager

To view the broker applications in Pivotal Cloud Foundry® Apps Manager, log into Apps Manager as an admin user and select the "system" org.



The applications are deployed in the "p-spring-cloud-services" space.



Service Instance Management

A service instance is backed by one or more Spring Boot applications deployed by the Worker in the "p-spring-cloud-services" org to the "instances" space.

A service instance is assigned a GUID at provision time. Backing applications for services include the GUID in their names:

Config Server

- config-[GUID]: A Spring Cloud Config server application.

Service Registry

- eureka-[GUID]: A Spring Cloud Netflix Eureka server application.

Circuit Breaker Dashboard

- hystrix-[GUID]: A Spring Cloud Netflix Hystrix server application.
- turbine-[GUID]: A Spring Cloud Netflix Turbine application.
- **rabbitmq-[GUID]**: A RabbitMQ for PCF service instance.

Access Service Instance Backing Applications in Apps Manager

To view a backing application for a service instance in Pivotal Cloud Foundry® Apps Manager, get the service instance's GUID and look for the corresponding application in the "instances" space.

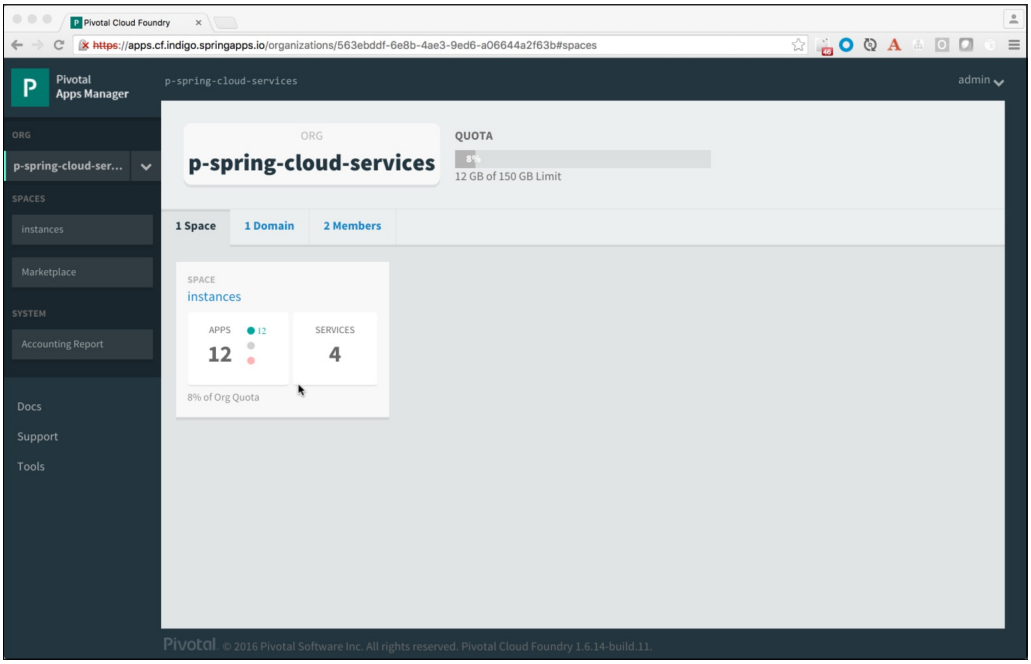
Target the org and space of the service instance.

```
$ cf target -o myorg -s development

API endpoint:   https://api.cf.wise.com (API version: 2.43.0)
User:           admin
Org:            myorg
Space:          development

$ cf services
Getting services in org myorg / space development as admin...
OK

name           service           plan      bound apps   last operation
config-server  p-config-server    standard  cook         update succeeded
```

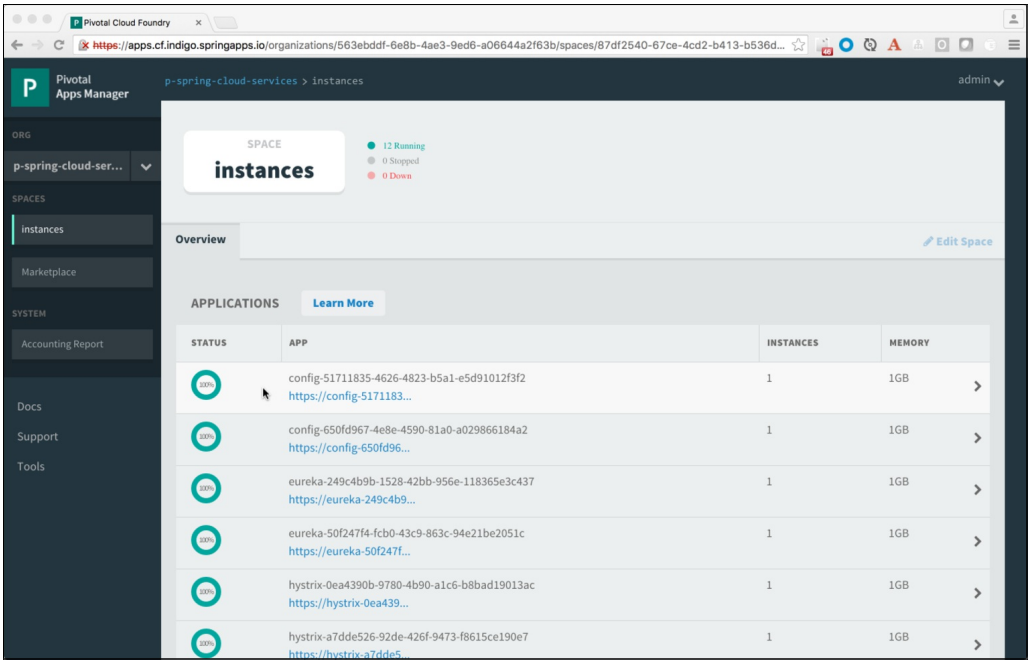
Run `cf service` with the `CF_TRACE` environment variable set to `true`. Copy the value of `resources.metadata.guid`, which is the service instance GUID.

```
$ CF_TRACE=true cf service config-server

REQUEST: [2016-06-27T20:45:24-05:00]
[...]

RESPONSE: [2016-06-27T20:45:25-05:00]
[...]

{
  "total_results": 1,
  "total_pages": 1,
  "prev_url": null,
  "next_url": null,
  "resources": [
    {
      "metadata": {
        "guid": "51711835-4626-4823-b5a1-e5d91012f3f2",
```

Log into Apps Manager as an admin user and select the "p-spring-cloud-services" org.



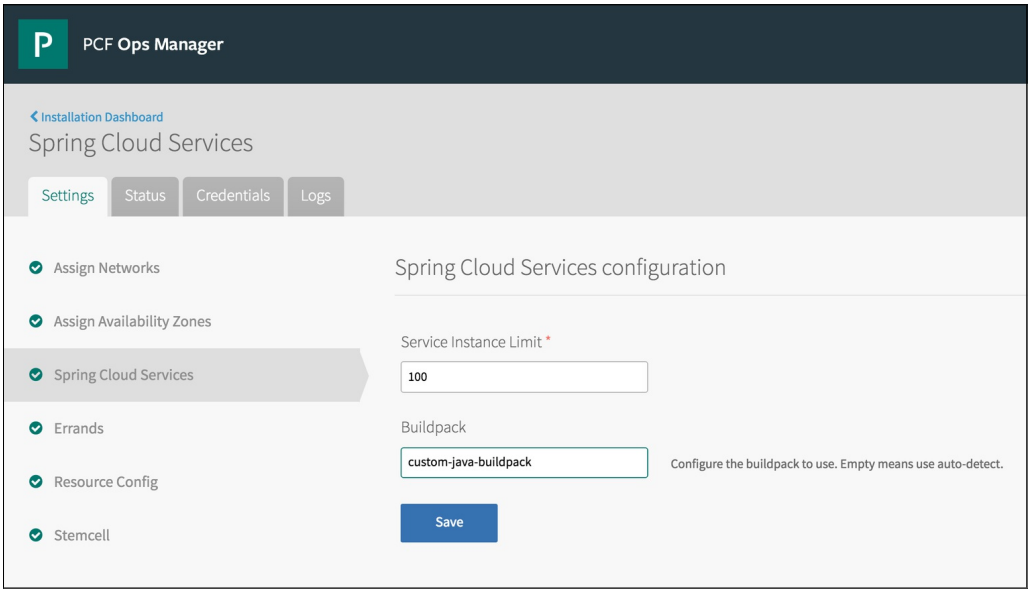
The applications are deployed in the "instances" space. Look for the backing application named as described above, with the prefix specific to the service type and the service instance GUID.



Set Buildpack for Service Instances

By default, the SB stages service instance backing applications using the buildpack chosen by the platform's buildpack detection; normally, this will be the highest-priority Java buildpack. To cause the SB to use a particular Java buildpack regardless of priority, you can set the name of the buildpack to use in the Spring Cloud Services tile settings.

In the Installation Dashboard of Ops Manager, click the Spring Cloud Services tile. Navigate to the **Settings** tab.



Click the **Spring Cloud Services** tab and enter the name of the desired Java buildpack in the **Buildpack** field. Click **Save**, return to the Installation Dashboard, and apply your changes. The SB will now use the selected buildpack to stage service instance backing applications.

UAA Identity Zones and Clients

Spring Cloud Services uses the multi-tenancy capabilities of the Cloud Foundry User Account and Authentication server (UAA). It creates a new Identity Zone ("the Spring Cloud Services Identity Zone") for all authorization from Config Server and Service Registry service instances to client applications which have bindings to these service instances.

Within the platform Identity Zone ("the UAA Identity Zone"), Spring Cloud Services creates a `p-spring-cloud-services` UAA client for the SB and a `p-spring-cloud-services-worker` UAA client for the Worker. In the Spring Cloud Services Identity Zone, it creates a `p-spring-cloud-services-worker` UAA client for the Worker.

In the UAA Identity Zone, it also creates the following clients, where `[GUID]` is the service instance's GUID:

- A `eureka-[GUID]` UAA client per Service Registry service instance.
- A `hystrix-[GUID]` UAA client per Circuit Breaker Dashboard service instance.

In the Spring Cloud Services Identity Zone, it also creates the following clients, where `[GUID]` is the service instance's GUID:

- A `config-server-[GUID]` UAA client per Config Server service instance.
- A `eureka-[GUID]` UAA client per Service Registry service instance.

Get Access Token for Direct Requests to a Service Instance

To make requests directly against a Config Server service instance's Spring Cloud Config Server backing application or a Service Registry service instance's Spring Cloud Netflix Eureka backing application, you can get an access token using the binding credentials of an application that is bound to the service instance.

Note: The following procedure uses the jq command-line JSON processing tool.

Run `cf env`, giving the name of an application that is bound to the service instance:

```
$ cf services
Getting services in org myorg / space development as admin...
OK

name            service          plan       bound apps   last operation
config-server   p-config-server  standard   cook         create succeeded

$ cf env cook
Getting env variables for app cook in org myorg / space development as admin...
OK

System-Provided:
{
 "VCAP_SERVICES": {
  "p-config-server": [
   {
    "credentials": {
     "access_token_uri": "https://p-spring-cloud-services.uaa.cf.wise.com/oauth/token",
     "client_id": "p-config-server-876cd13b-1564-4a9a-9d44-c7c8a6257b73",
     "client_secret": "rU7dMUw6bQjR",
     "uri": "https://config-86b38ce0-eed8-4c01-adb4-1a651a6178e2.apps.wise.com"
    },
[...]
```

Then run the following Bash script, which fetches a token and uses the token to access an endpoint on a service instance backing application:

```
TOKEN=$(curl -k ACCESS_TOKEN_URI -u CLIENT_ID:CLIENT_SECRET -d
grant_type=client_credentials | jq -r .access_token); curl -k -H
"Authorization: bearer $TOKEN" -H "Accept: application/json"
URI/ENDPOINT | jq
```

In this script, replace the following placeholders using values from the `cf env` command above:

- `ACCESS_TOKEN_URI` with the value of `credentials.access_token_uri`
- `CLIENT_ID` with the value of `credentials.client_id`
- `CLIENT_SECRET` with the value of `credentials.client_secret`
- `URI` with the value of `credentials.uri`

Replace `ENDPOINT` with the relevant endpoint:

- `application/profile` to retrieve configuration from a Config Server service instance
- `eureka/apps` to retrieve the registry from a Service Registry service instance

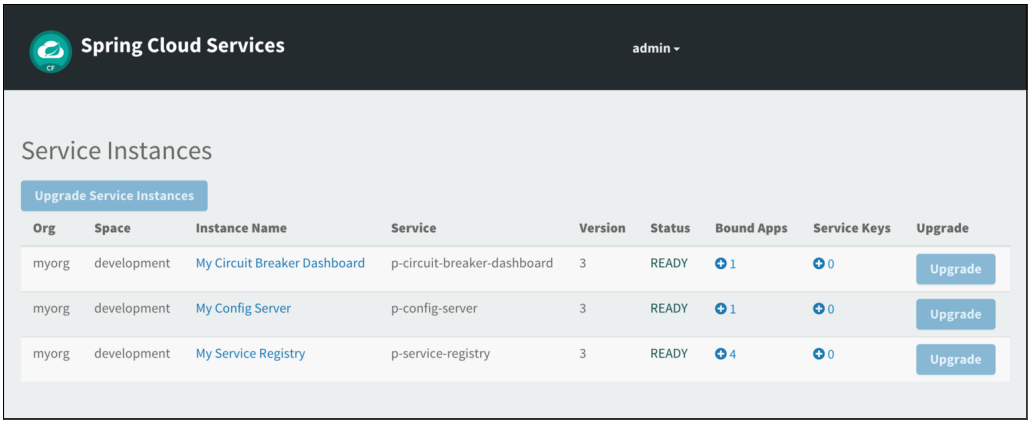
The Service Instances Dashboard

To view the status of individual service instances, visit the Service Instances dashboard. You can access it at the following URL, where `SCS_BROKER_URL` is the URL of the SB (spring-cloud-broker):

```
SCS_BROKER_URL/admin/serviceInstances
```

Locate the SB as described in the Access Broker Applications in Apps Manager section. The Service Instances dashboard is also linked to on the main page of the SB.

The dashboard shows the version and status of each service instance, as well as other information including the number of applications that are bound to the instance. It also provides an **Upgrade** button for each service instance and an **Upgrade Service Instances** button; these buttons may be enabled if any service instances shown in the dashboard are not at the version included with the currently-installed Spring Cloud Services product. For more information about upgrading service instances, see the Service Instance Upgrade Steps section of the Upgrades topic.



You can click the **Instance Name** of a listed service instance to view the instance's dashboard. Click the **+** icon beside the count of an instance's **Bound Apps** or **Service Keys** to view the names of the applications or service keys that are bound to that instance.

Note: The Service Instances dashboard is updated frequently (close to real-time). If using the Cloud Foundry Command Line Interface tool (cf CLI), you may notice a discrepancy between the status given for a service instance by the cf CLI (e.g., by the `cf service` command) versus that given by the Service Instances dashboard. The status retrieved by the cf CLI is not updated as frequently and may take time to match that shown on the Service Instances dashboard.

Application Health and Status

For more visibility into how Spring Cloud Services service instances and the broker applications are behaving, or for troubleshooting purposes, you may wish to access those applications directly. See below for information about accessing their output.

Read Broker Application Logs

To access logs for the SB and Worker applications, target the "system" org and its "p-spring-cloud-services" space:

```
$ cf target -o system -s p-spring-cloud-services

API endpoint:   https://api.cf.wise.com (API version: 2.43.0)
User:           admin
Org:            system
Space:          p-spring-cloud-services
Ben-Kleins-MacBook-Pro:Work bklein$ cf apps
Getting apps in org system / space p-spring-cloud-services as admin...
OK

name                     requested state   instances   memory   disk   urls
spring-cloud-broker      started           1/1         1G       1G     spring-cloud-broker.apps.wise.com
spring-cloud-broker-worker   started       1/1         1G       1G     spring-cloud-broker-worker.apps.wise.com
```

Then you can use `cf logs` to tail logs for either the SB:

```
$ cf logs spring-cloud-broker
Connected, tailing logs for app spring-cloud-broker in org system / space p-spring-cloud-services as admin...
```

or the Worker:

```
$ cf logs spring-cloud-broker-worker
Connected, tailing logs for app spring-cloud-broker-worker in org system / space p-spring-cloud-services as admin...
```

Read Backing Application Logs

To access logs for service instance backing applications, target the "p-spring-cloud-services" org and its "instances" space:

```
$ cf target -o p-spring-cloud-services -s instances

API endpoint:   https://api.cf.wise.com (API version: 2.43.0)
User:           admin
Org:            p-spring-cloud-services
Space:          instances
$ cf apps
Getting apps in org p-spring-cloud-services / space instances as admin...
OK

name                                requested state   instances   memory   disk   urls
config-86b38ce0-eed8-4c01-adb4-1a651a6178e2   started   1/1   1G   1G   config-86b38ce0-eed8-4c01-adb4-1a651a6178e2.apps.wise.com
eureka-493b6b17-512a-4961-8f85-6178251fe2fa   started   1/1   1G   1G   eureka-493b6b17-512a-4961-8f85-6178251fe2fa.apps.wise.com
hystrix-ff835bde-5b3a-4623-a57f-8d88028b6376   started   1/1   1G   1G   hystrix-ff835bde-5b3a-4623-a57f-8d88028b6376.apps.wise.com
turbine-ff835bde-5b3a-4623-a57f-8d88028b6376   started   1/1   1G   1G   turbine-ff835bde-5b3a-4623-a57f-8d88028b6376.apps.wise.com
```

Then you can use `cf logs` to tail logs for a backing application.

```
$ cf logs config-86b38ce0-eed8-4c01-adb4-1a651a6178e2
Connected, tailing logs for app config-86b38ce0-eed8-4c01-adb4-1a651a6178e2 in org p-spring-cloud-services / space instances as admin...
```

Access Actuator Endpoints

The SB and Worker applications, as well as backing applications for service instances, use Spring Boot Actuator. Actuator adds a number of endpoints to these applications; some of the added endpoints are summarized below.

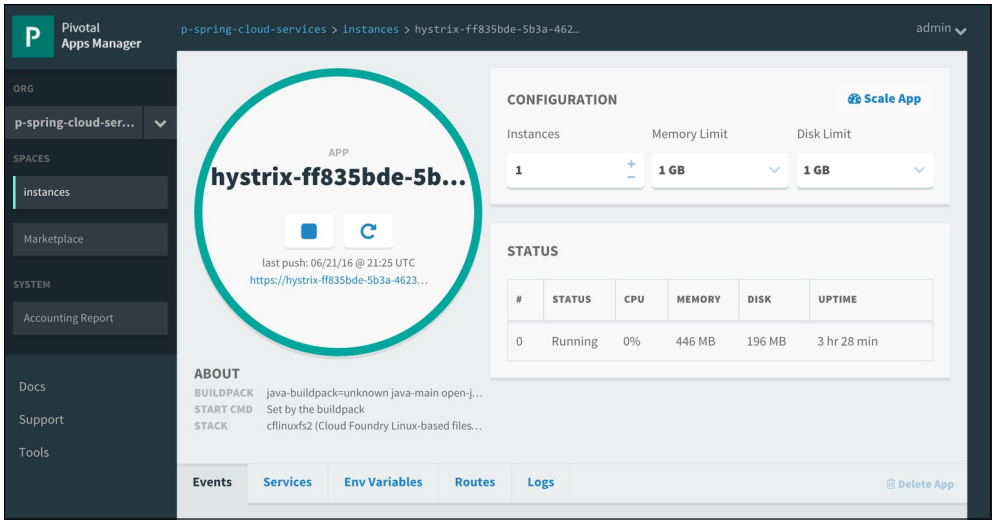
ID	Function
`env`	Displays profiles, properties, and property sources from the application environment
`health`	Displays information about the health and status of the application
`metrics`	Displays metrics information from the application
`mappings`	Displays list of `@RequestMapping` paths in the application
`shutdown`	Allows for graceful shutdown of the application. Disabled by default; not enabled in Spring Cloud Services broker or instance-backing applications

See the Endpoints section of the Actuator documentation for the full list of endpoints.

Endpoints on SB, Worker, Service Registry, or Circuit Breaker Dashboard

The SB application, the Worker application, the Service Registry's Eureka backing application, and the Circuit Breaker Dashboard's Hystrix backing application use Dashboard SSO. To access Actuator endpoints on one of these applications, you must be authenticated as a Space Developer in the application's space and have a current session with the application.

1. Log in to Apps Manager as an admin user and navigate to the relevant application: for the SB or Worker, access the SB application or Worker application as described in the The Service Broker section; for a Service Registry or Circuit Breaker Dashboard service instance, access the backing application as described in the Service Instances section.

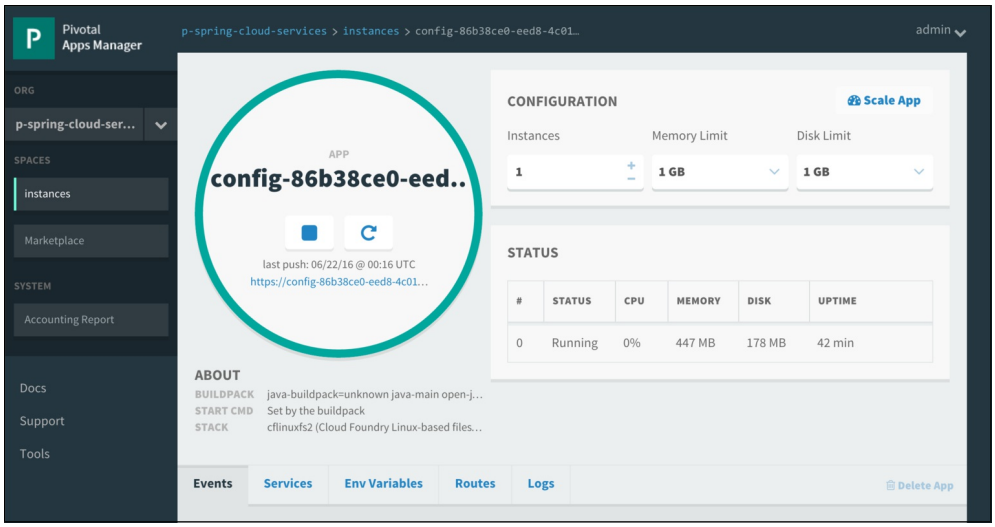


2. Visit the application's URL, appending the endpoint ID to that URL; e.g., for the `health` endpoint on a Circuit Breaker Dashboard service instance's Hystrix backing application, this would be something like `https://hystrix-ff835bde-5b3a-4623-a57f-8d88028b6376.apps.wise.com/health`.

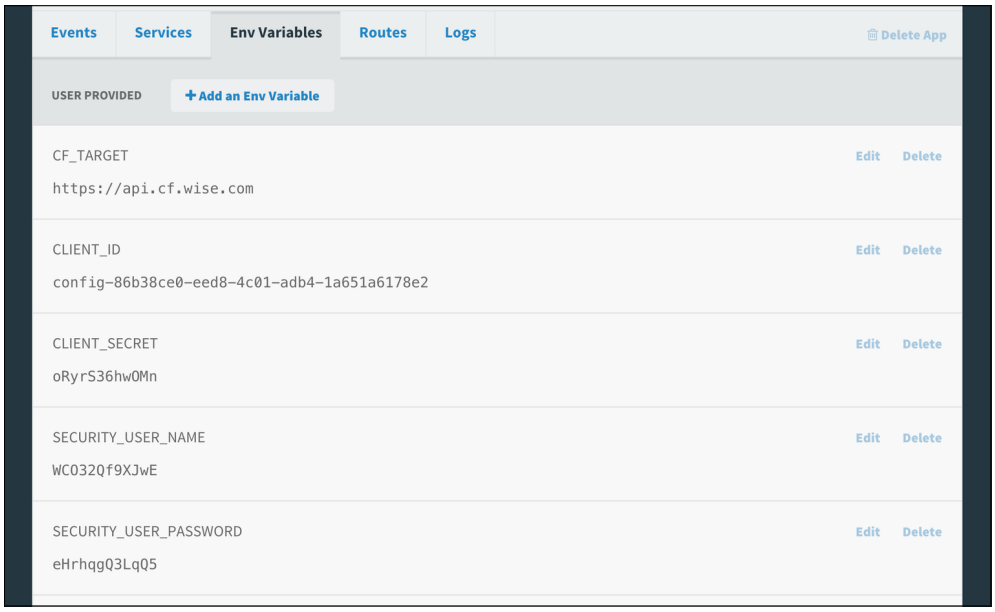
Endpoints on Config Server

The Config Server's Spring Cloud Config Server backing application uses HTTP Basic authentication. To access Actuator endpoints on this application, you must authenticate with the credentials stored in the application's environment variables.

1. Log in to Apps Manager as an admin user and navigate to the relevant application, as described in the Service Instances section.



2. From the **Env Variables** tab, copy the values of the `SECURITY_USER_NAME` and `SECURITY_USER_PASSWORD` environment variables.



3. Visit the application's URL, appending the endpoint ID to that URL; e.g., for the `health` endpoint, this would be something like `config-86b38ce0-eed8-4c01-adb4-1a651a6178e2.apps.wise.com/health`. When challenged, provide the values of `SECURITY_USER_NAME` and `SECURITY_USER_PASSWORD` from Step 2.

Invoke Config Server Endpoints

To view the configuration properties that a Config Server service instance is returning for an application, you can access the configuration endpoints on the service instance's Spring Cloud Config Server backing application directly.

1. Obtain an access token for interacting with the service instance, as described in the Get Access Token for Direct Requests to a Service Instance section. In Step 1 of that section, copy the URL in `credentials.uri` from the service instance's entry in the `VCAP_SERVICES` environment variable.

2. Make a request of the Config Server service instance backing application in the format `http://SERVER/APPLICATION_NAME/PROFILE`, where `SERVER` is the URL from `credentials.uri` as mentioned in Step 1, `APPLICATION_NAME` is the application name as set in the `spring.application.name` property, and `PROFILE` is the name of a profile that has a configuration file in the repository.

   An example request URL might look like this:

   ```
   https://config-86b38ce0-eed8-4c01-adb4-1a651a6178e2.apps.wise.com/cook/production
   ```

   Or, for the `default` profile:

   ```
   https://config-86b38ce0-eed8-4c01-adb4-1a651a6178e2.apps.wise.com/cook/default
   ```

   You can make the request using curl, providing the token—`TOKEN` in the below example—in a header with the `-H` or `--header` option:

   ```
   $ curl -H 'Authorization: bearer TOKEN_STRING' https://config-86b38ce0-eed8-4c01-adb4-1a651a6178e2.apps.wise.com/cook/default
   {"name":"cook","profiles":["default"],"label":null,"version":"7b5da0d68d9237f2852f7ac6c5e7474fd433c3f3","propertySources":[{"name":"https://github.com/spring-cloud-services-samp
   ```

For a list of path formats that the Config Server accepts, see the Request Paths section of the The Config Server topic in the Config Server documentation.

Capacity Requirements

Below are usage requirements of the applications backing a single service instance (SI) of each Spring Cloud Services service type.

Service Type	Memory Limit / SI	Disk Limit / SI
Config Server	1 GB	1 GB
Service Registry	1 GB	1 GB
Circuit Breaker Dashboard	2 GB	2 GB

Spring Cloud Services service types may also be backed by non-SCS service instances. For example, a Circuit Breaker Dashboard service instance uses a RabbitMQ for Pivotal Cloud Foundry service instance for communication between its two backing applications.

Security Overview for Spring Cloud Services

Page last updated:

Glossary

The following abbreviations, example values, and terms are used in this topic as defined below.

- *CC*: The Cloud Foundry Cloud Controller.
- *CC DB*: The Cloud Controller database.
- *Dashboard SSO*: Cloud Foundry's Dashboard Single Sign-On.
- *domain.com*: The value configured by an administrator for the Cloud Foundry system domain.
- *Operator*: A user of Pivotal Cloud Foundry® Operations Manager.
- *SB*: The Spring Cloud Services Service Broker.
- *SCS*: Spring Cloud Services.
- *UAA*: The Cloud Foundry User Account and Authentication Server.

A Note on HTTPS

All components in SCS force HTTPS for all inbound requests. Because SSL terminates at the load balancer, requests are deemed to originate over HTTPS by inspecting the `X-Forwarded-For`, `X-Forwarded-Proto`, and `X-Forwarded-Port` headers. More on how this is implemented can be found in the Spring Boot documentation.

All outbound HTTP requests made by SCS components are also made over HTTPS. These requests nearly always contain credentials, and are made to other components within the Cloud Foundry environment. In an environment that uses self-signed certificates in the HA proxy configuration, outbound HTTPS requests to other components would fail because the self-signed certificate would not be trusted by the JVM's default truststore (e.g. `cacerts`). To get around this, all components use the cloudfoundry-certificate-truster to add the CF environment's SSL certificate to the JVM's truststore on application startup.

The SSL certificate used by the CF environment must also include Subject Alternative Names (SANs) for domain wildcards `*.login.domain.com` and `*.uaa.domain.com`. This is needed for the correct operation of Multi-tenant UAA, which relies on subdomains of UAA.

A Note on Multi-Tenant UAA

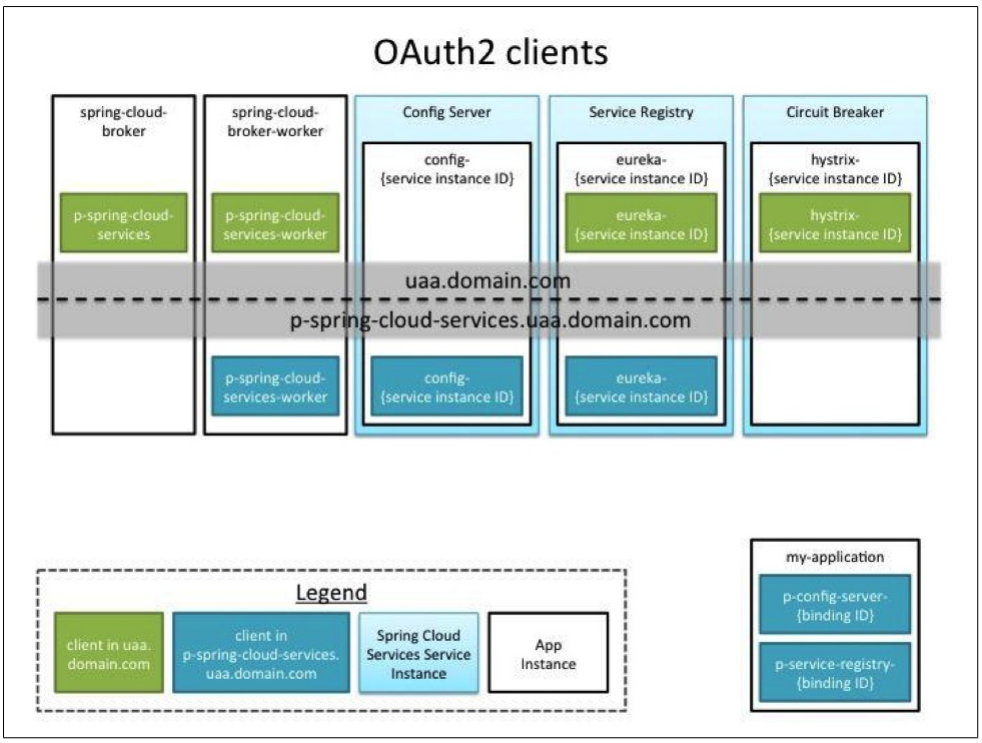
SCS uses the multi-tenancy features of UAA to implement "the principle of least privilege". This is required because SCS creates and deletes OAuth clients when applications bind and unbind to service instances. These clients must also have non-empty authorities. In order to create create clients with arbitrary authorities, the actor must have the scopes `uaa.admin` and `clients.write`; essentially they must be the admin.

Making admin-level credentials (e.g. the UAA admin client) accessible to an application is dangerous and should be avoided. For example, if one were to break into that application and get those credentials, the credentials could be used to affect the entire CF environment. This is why SCS operates in two UAA domains (also called Identity Zones).

The platform Identity Zone (e.g. `uaa.domain.com`) contains the users of SCS (e.g. Space Developers) and the Dashboard SSO clients used by each Service Instance. An admin-level client is not required for creating and deleting SSO clients because the SSO client's scope values are fixed and only the most basic `uaa.resource` authority is needed by the SSO client.

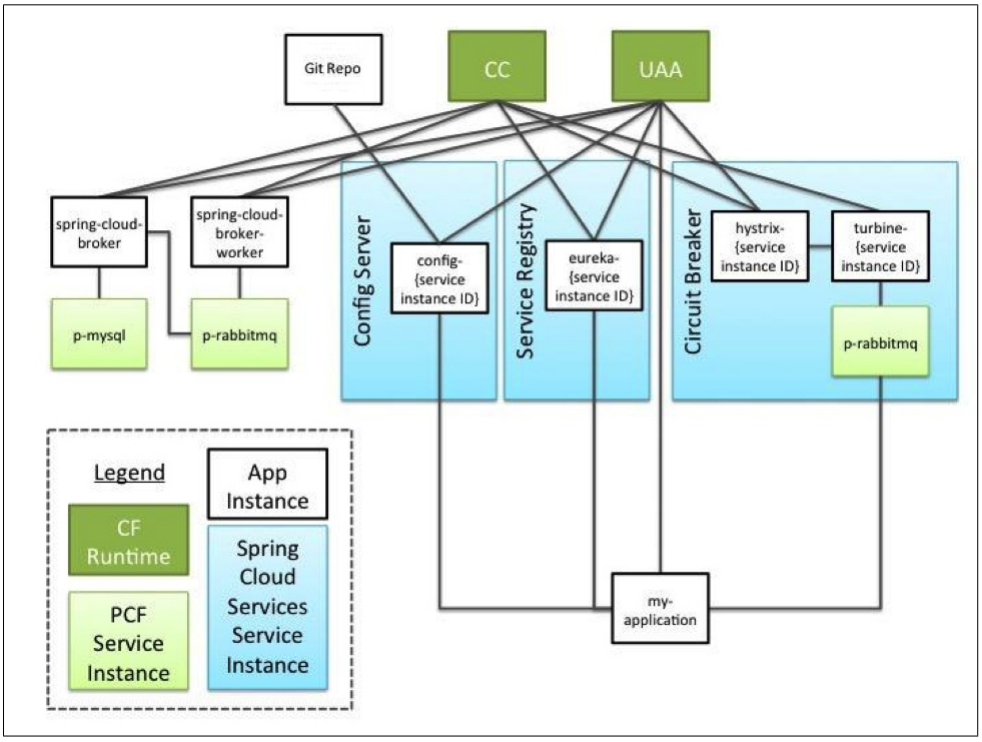
The other Identity Zone is specific to SCS (e.g. `p-spring-cloud-services.uaa.domain.com`). This Identity Zone contains no users, but it contains the clients used by bound applications to access protected resources on SCS service instances. These clients require dynamic authority values, which can only be created by an admin-level actor. This admin-level actor (the p-spring-cloud-services-worker client) also exists in the Spring Cloud Services Identity Zone, but because it exists in this Identity Zone, it cannot affect anything in the platform Identity Zone. If these credentials were leaked, the damage would be limited to SCS.

The following diagram illustrates the OAuth clients used by SCS and the Identity Zones in which they exist.



Spring Cloud Services Components

Before continuing, you should familiarize yourself with the following diagram, which shows the direct lines of communication between application components.



Core Components

The Installation File

The installation file is the `.pivotal` file that contains the Spring Cloud Services product.

The installation file is generated from source code repositories hosted on `github.com`. The repositories are can only be accessed by authorized persons and cannot be accessed over a non-encrypted channel. No credentials are stored in any source repository used by Spring Cloud Services.

Concourse is used as the build pipeline to generate the installation file. The infrastructure that hosts Concourse can only be accessed from within the Pivotal network, using a username and password stored internally by Concourse. The build pipeline configuration contains credentials to the S3 bucket which hosts the installation file and intermediate artifacts, as well as the GitHub API key providing read/write access to the source code repositories. The resulting installation file built by the Concourse pipeline does not contain any credentials.

The installation file is downloaded from https://network.pivotal.io, can only be accessed by authorized persons, and cannot be accessed over a non-encrypted channel.

To install Spring Cloud Services, the installation file must be uploaded to Pivotal Cloud Foundry® Operations Manager. Ops Manager can only be accessed over HTTPS by persons knowing the username and password for Ops Manager.

app spring-cloud-broker

The spring-cloud-broker application (the SB) is responsible for receiving Service Broker API requests from the Cloud Controller (CC), and hosts the primary dashboard UI for all service types.

Entry Points

The Service Broker API

Service Broker API endpoints require HTTPS and Basic authentication. Valid credentials for Basic authentication are made available to the SB via environment variables, and are therefore stored in the CC database in encrypted form. The CC also makes Service Broker API requests, and the credentials used to make these API requests are stored in the CC DB in encrypted form as well.

Service Broker Dashboard

Dashboard endpoints require HTTPS and an authenticated session. Unauthenticated requests are redirected to UAA to initiate the OAuth 2 Authorization Code flow as documented here; for the flow to complete, the user must be authenticated with UAA. Once the token is obtained, the session is authenticated. The token is then used to access the CC API to check permissions on the service instance being accessed, as documented here. This flow is typical of Dashboard Single Sign-On for Service Instances.

The service instance ID used in the permission check is the first GUID that is present in the URL, and this value is also used by the rest of the SB application to identify the service instance that the user is trying to access.

GET /dashboard/instance/{serviceInstanceId}

This endpoint returns service instance details such as service name, plan ID, org, and space, as well as credentials that need to be propagated to applications bound to this service instance. Because the service instance permission check is performed, this endpoint is only accessible to Space Developers who can bind applications to this service instance. Once an application is bound to this service instance, a Space Developer can see the same credentials returned by this endpoint in the bound application's binding credentials (e.g. via Pivotal Cloud Foundry Applications Manager.)

GET|POST /dashboard/instance/{serviceInstanceId}/env

This endpoint gets or modifies environment variables for the service instance's backing application. Environment variables that can be viewed or modified with this endpoint must be whitelisted; this whitelisting can only be modified by the Operator or the developers of Spring Cloud Services. Each service type has its own whitelist, and the only service type with whitelisted environment variables is Config Server. The Config Server's whitelisted environment variables specify the repository type, the URI of the repository, and the username and password used to access the repository. Any POST to this endpoint will result in a restart of the backing application, regardless of whether any environment variables were actually modified.

GET /dashboard/instance/{serviceInstanceId}/health

This endpoint returns the response of the `/health` endpoint on the backing application. The `/health` endpoint is provided by Spring Boot Actuator and is accessed anonymously. This is used by the Config Server configuration page to indicate if there are any problems with the Config Server's configuration.

Caching the Service Instance Permission Check

The service instance permission check is cached in session (if available). The cache is used only during GET, HEAD, and OPTIONS requests, with the exception of the `/instances/{service_instance_guid}/env` endpoint. Any request for this endpoint does not use the cache, because this endpoint exposes application environment variables—and, in the case of Config Server, the username and password used to access the Config Server's backing repository.

Caching the permission check in this manner avoids the load and extra round trip to the CC for doing the permission check, while still checking permissions before performing any critical operation.

Actuator Endpoints

Actuator endpoints are enabled and require HTTPS and an authenticated session. The token is obtained from UAA via the OAuth 2 Authorization Code flow as documented here; the token is then used to make a request to the CC `/v2/apps/:guid/env` endpoint, which can only be accessed by Space Developers in the space that hosts the SB. The GUID used in the request is extracted from the `VCAP_APPLICATION` environment variable, whose value is given by the CC. The only user that can access these endpoints is the Operator.

This Actuator SSO flow is used by other components that already use Dashboard SSO, as no additional dependencies are required to enable this.

External Dependencies

p-mysql

The SB uses a p-mysql service instance to store information about SCS service instances. The most sensitive information stored here is credentials for the p-rabbitmq instances used for the Circuit Breaker service instances, which could be used to disable the Hystrix dashboard as described in app turbine-{guid} > External Dependencies > p-rabbitmq. The only way to access the data in this p-mysql service instance is through the SB's binding credentials or directly from the filesystem, and these would only be accessible to the Operator.

p-rabbitmq

The SB uses a p-rabbitmq service instance to communicate with spring-cloud-broker-worker (Worker). The messages passed propagate the provision, deprovision, bind, and unbind requests received by the SB API to the Worker, as well as getting and setting application environment variables for service instance backing applications in the “instances” space. The credentials for accessing the p-rabbitmq service instance are provided through the SB’s `VCAP_SERVICES` environment variable as a result of binding to the service instance. The credentials would only be visible to a Space Developer in the “p-spring-cloud-services” space, and only the Operator would have this access.

The Cloud Controller

The SB communicates to the CC via HTTPS to perform permission checks using the current user’s token as described in the Service Broker Dashboard section, and to derive URIs for UAA. The URI to the CC is set at installation time in the SB’s environment variables, under the name `CF_TARGET`. The environment variable could be modified so that the user’s token is sent to another party. The environment variable can only be modified by a Space Developer in the “p-spring-cloud-services” space, and only the Operator would have this access.

UAA

The SB communicates with UAA via HTTPS to enable Dashboard SSO. All requests to UAA are authenticated as per the OAuth 2 specification, using the p-spring-cloud-services client credentials. The URI to UAA is derived from the CC API `/v2/info` endpoint, whose threat mitigations are described in the previous section.

OAuth Clients

p-spring-cloud-services

- **Identity Zone**: UAA
- **Grant Type**: Authorization Code
- **Redirect URI**: https://spring-cloud-broker.domain.com/dashboard/login
- **Scopes**: `cloud_controller.read`, `cloud_controller.write`, `cloud_controller_service_permissions.read`, `openid`
- **Authorities**: `uaa.resource`
- **Token expiry**: default (12 hours)

This client is used for SSO with UAA. The scopes allow the SB to access the Cloud Controller API on the user’s behalf, and are auto-approved. The `uaa.resource` authority allows the SB to access the token verification endpoints on UAA. The client ID and client secret are made available to the SB via environment variables, which are set at installation time and are stored in encrypted form in the CC DB.

app spring-cloud-broker-worker

The spring-cloud-broker-worker application (the Worker) is responsible for managing service instance backing apps. Some of this work is done asynchronously from the requests that initiate it.

Entry Points

The RabbitMQ Message Listener

The Worker listens for messages posted to the p-rabbitmq service instance. The SB posts these messages as described in app spring-cloud-broker > External Dependencies > p-rabbitmq. Only the Operator, the SB, and the Worker can access this instance of p-rabbitmq.

Actuator Endpoints

Actuator endpoints are enabled and require HTTPS and Basic authentication. Credentials that provide this access are set at installation time in the Worker’s environment variables. These environment variables are only accessible to the Operator.

External Dependencies

p-rabbitmq

The Worker uses a p-rabbitmq service instance to receive messages from the SB. The messages received originate from the provision, deprovision, bind, and unbind requests received by the SB API, as well as from the `/dashboard/instance/{serviceInstanceId}/env` endpoint. The credentials for accessing the p-rabbitmq service instance are provided through the Worker’s `VCAP_SERVICES` environment variable as a result of binding to the service instance. The credentials would only be visible to a Space Developer in the “p-spring-cloud-services” space, and only the Operator would have this access.

The Cloud Controller

The Worker communicates to the CC via HTTPS to carry out management tasks for service instance backing apps. All backing applications reside in the “p-spring-cloud-services” org, “instances” space. The Worker uses its own user credentials to obtain a token for accessing the CC API and acts as a Space Developer in the “instances” space.

The URI to the CC is set at installation time in the Worker’s environment variables, under the name `CF_TARGET`, which is set at installation time and can only be modified by the Operator.

UAA

The Worker uses the client management APIs of UAA to create and delete clients in both the platform and Spring Cloud Services Identity Zones. All requests are authenticated by including the OAuth 2 bearer token in the request, and are made over HTTPS. The credentials used in these requests are detailed in the OAuth Clients section. The URI to UAA is derived from the CC API `/v2/info` endpoint.

OAuth Clients

p-spring-cloud-services-worker

- **Identity Zone**: UAA

Grant Type: Client Credentials
Redirect URI: https://spring-cloud-broker.domain.com/dashboard/login
Scopes: `cloud_controller.read`, `cloud_controller_service_permissions.read`, `openid`
Authorities: `clients.write`
Token expiry: default (12 hours)

This client is used to create and delete SSO clients for each Service Registry and Circuit Breaker Dashboard service instance, which use Dashboard SSO for their own dashboards. The grant type is Client Credentials, which allows the Worker to act on its own. The `clients.write` authority allows the Worker to create and delete clients, but this client is limited in the kinds of clients which it can create. The scopes that are registered allow this client to create other clients with the same scopes, but these clients cannot have any authorities. In other words, clients created via this client cannot act on their own, and can only act on behalf of a user within the scopes that are registered for this client. This limitation prevents privilege escalation.

While arbitrary clients cannot be created via this client, this client is able to delete any client in the UAA Identity Zone due to the `clients.write` authority.

The client ID and client secret are made available to the SB via environment variables, which are set at installation time and are stored in encrypted form in the CC DB. The credentials are only visible to the Operator.

p-spring-cloud-services-worker

Identity Zone: Spring Cloud Services
Grant Type: Client Credentials
Authorities: `clients.read`, `clients.write`, `uaa.admin`
Token expiry: default (12 hours)

This client is used to create and delete clients in the Spring Cloud Services Identity Zone for each Config Server and Service Registry service instance. The grant type is Client Credentials, which allows the Worker to act on its own. The `uaa.admin` authority allows the Worker to create and delete clients in the Spring Cloud Services Identity Zone without any limitations, unlike the corresponding client in the UAA Identity Zone. However, these privileges do not extend into the UAA Identity Zone.

The client ID and client secret are the same as the corresponding client in the UAA Identity Zone.

Users

p-spring-cloud-services

This user is a Space Developer in the “p-spring-cloud-services” org, “instances” space. The user has no other roles. The username and password are made available to the Worker via environment variables, which are set at installation time and are stored in encrypted form in the CC DB. The credentials are only visible to the Operator.

Config Server Service Instances

app config-server-{guid}

The config-server application is a backing application for Config Server service instances. The GUID in the application name is the service instance ID. This application is responsible for handling requests for configuration values from bound applications.

Entry Points

Config Server REST endpoints

The following entry points are defined by Spring Cloud Config Server.

GET /{application}/{profile}[/{label}]

This returns configuration values for a requesting application. The request must be authenticated with an OAuth 2 Bearer token issued by the Spring Cloud Services Identity Zone. The following claims are checked:

- `aud`: must equal `config-server-[guid]`
- `iss`: must equal `https://p-spring-cloud-services.uaa.domain.com/oauth/token`
- `scope`: must equal `config-server-[guid].read`

The GUID in the `aud` and `scope` values must match the `SERVICE_INSTANCE_ID` environment variable that is set in the Config Server application at provision time.

GET /health

This is used by the Dashboard UI for checking if the Config Server is configured properly. This endpoint can be accessed anonymously, and only returns `{"status":"UP"}` or `{"status":"DOWN"}`.

OAuth 2 Clients for Bound Applications

To provide access to bound applications, each SB bind request creates the following OAuth 2 client:

Client ID: p-config-server-[bindingId]
Identity Zone: Spring Cloud Services
Grant Type: Client Credentials
Scopes: `uaa.none`
Authorities: `p-config-server-[guid].read`
Token expiry: default (12 hours)

The client ID and client secret for this client are provided to the bound application via the binding credentials in the `VCAP_SERVICES` environment variable. Only a Space Developer in the space that contains the bound application would have access to this.

No Application-Level Access Control

Other than checking for the claims mentioned in the previous section, no other attributes are considered when making an access control decision. Because of this, any application bound to the service instance will be able to access any configuration served by this Config Server.

Actuator Endpoints

Actuator endpoints are enabled and require HTTPS and Basic authentication, with the exception of `/health` as described above. Credentials that provide this access are set at provision time in the config-server application's environment variables. These environment variables are only accessible to the Operator.

External Dependencies

Git repository

The actual configurations are stored in a Git repository and retrieval of these configurations by the Config Server is subject to the Git repository's security requirements. The URI and the username and password (if applicable) are set by the Space Developer that configures the service instance. The UI gets and sets these credentials through the Service Broker's `/dashboard/instances/{guid}/env` endpoint, so that the credentials are made available to the Config Server via environment variables (and hence stored encrypted in the CC DB).

UAA

The Config Server accesses the `/token_key` endpoint on UAA to retrieve the token verification key. This key material is used to verify the JWT signature of the token in order to authenticate the request.

OAuth Clients

config-server-{guid}

> **Identity Zone**: Spring Cloud Services
> **Grant Type**: Client Credentials
> **Scopes**: `uaa.none`
> **Authorities**: `uaa.resource`
> **Token expiry**: default (12 hours)

The `uaa.resource` authority allows the config-server application to access the token verification endpoints on UAA. The client is created by the p-spring-cloud-services-worker client at provision time. The client ID and client secret are made available to the config-server application via environment variables set at provision time, and are only visible to the Operator.

Service Registry Service Instances

app eureka-{guid}

The Eureka application is a backing application for Service Registry service instances. The GUID in the application name is the service instance ID. This application hosts a REST API for the Service Registry and a dashboard UI for viewing the status of the Registry.

Entry Points

Eureka REST endpoints

These entry points are defined by Netflix Eureka. Instead of enumerating every endpoint, we will explain the differences in securing the HTTP verbs.

GET

All GET endpoints must be authenticated with an OAuth 2 Bearer token issued by the Spring Cloud Services Identity Zone. The following claims are checked:

- `aud`: must equal `p-service-registry-[guid]`
- `iss`: must equal `https://p-spring-cloud-services.uaa.domain.com/oauth/token`
- `scope`: must equal `p-service-registry-[guid].read`

The GUID in the `aud` and `scope` values must match the `SERVICE_INSTANCE_ID` environment variable that is set in the Eureka application at provision time.

POST|PUT|DELETE

All POST, PUT, and DELETE endpoints must be authenticated with an OAuth 2 Bearer token issued by the Spring Cloud Services Identity Zone. The following claims are checked:

- `aud`: must equal `p-service-registry-[guid]`
- `iss`: must equal `https://p-spring-cloud-services.uaa.domain.com/oauth/token`
- `scope`: `must equal p-service-registry-[guid].write`

The GUID in the `aud` and `scope` values must match the `SERVICE_INSTANCE_ID` environment variable that is set in the Eureka application at provision time.

Record Level Access Control

In addition to checking token claims, further checks are done on POST, PUT, and DELETE requests to ensure that a Eureka Application can only be created or modified by a single CF Application. Before continuing, we should define the following Eureka domain objects:

- **Application**: This is identified by appID. CF Applications that register with Eureka will use their `spring.application.name` for this value. When looking up a service, CF Applications will look up Instances via their appID.
- **Instance**: Applications have one or more Instances. CF applications that register with Eureka are actually registering themselves as Instances of an Application. An Application does not exist without Instances; in other words, an Application exists only because an Instance refers to one by appID.

To ensure that a Eureka Application can only be registered by a single CF Application, the Eureka server was modified to record the CF Application's identity, which is conveyed by the `sub` claim of the OAuth 2 Bearer token. This value is saved in the Instance metadata under the key `registrant_principal`. When an Instance is registered (or for any other modification request), if there are other Instances for the same Application, the `registrant_principal` values of the other Instances are checked and must equal the principal of the incoming request; otherwise, the request is rejected.

This scheme could allow multiple CF Applications to register themselves under the same Application ID, if at first there are no other Instances for that Application. In this case, each registration request would be received and handled as if they are the first Instances for that Application. Due to how the `registrant_principal` values are looked up (no locks are placed for performance reasons), this race condition is possible. However, once this state is saved, resulting in multiple `registrant_principal` values for the same Application, any further modification requests made for that application will fail, regardless of who makes the request. The Eureka server will also log this specific error. Because no state modification requests, including heartbeat requests, would be accepted, these Instances would eventually expire.

OAuth 2 Clients for Bound Applications

To provide access to the Eureka REST API for bound applications, each SB bind request creates the following OAuth 2 client:

> **Client ID**: p-service-registry-[bindingId]
> **Identity Zone**: Spring Cloud Services
> **Grant Type**: Client Credentials
> **Scopes**: `uaa.none`
> **Authorities**: `p-service-registry-[guid].read`, `p-service-registry-[guid].write`
> **Token expiry**: default (12 hours)

The client ID and client secret for this client is provided to the bound application via the binding credentials in the `VCAP_SERVICES` environment variable. Only a Space Developer in the space that contains the bound application would have access to this.

Eureka Dashboard

The Eureka Dashboard requires the typical Dashboard SSO flow. The service instance ID used in the permission check is supplied by an environment variable set at provision time by the Worker. The service instance permission check is cached in the same manner as the checks done by the service broker.

Actuator Endpoints

Actuator endpoints require the same Actuator SSO flow used by the Service Broker.

External Dependencies

UAA

The Eureka Server accesses the `/token_key` endpoint on UAA to retrieve the token verification key. This key material is used to verify the JWT signature of the token in order to authenticate the request.

The Cloud Controller

The SB communicates to the CC via HTTPS to perform permission checks using the current user's token, as described in the Entry Points section, and to derive URIs for UAA. The URI to the CC is set at installation time in the SB's environment variables, under the name `CF_TARGET`. The environment variable could be modified so that the user's token is sent to another party. The environment variable can only be modified by a Space Developer in the "p-spring-cloud-services" space, and only the Operator would have this access.

OAuth Clients

eureka-{guid}

> **Identity Zone**: UAA
> **Grant Type**: Authorization Code
> **Redirect URI**: https://eureka-{guid}.domain.com/dashboard/login
> **Scopes**: `openid`, `cloud_controller.read`, `cloud_controller_service_permissions.read`
> **Authorities**: `uaa.resource`
> **Token expiry**: default (12 hours)

This client is used for Dashboard SSO with UAA. The scopes allow the Eureka application to access the Cloud Controller API on the user's behalf, and are auto-approved. The `uaa.resource` authority allows the Eureka application to access the token verification endpoints on UAA. The client is created by the p-spring-cloud-services-worker client at provision time. The client ID and client secret are made available to the Eureka application via environment variables set at provision time.

eureka-{guid}

> **Identity Zone**: Spring Cloud Services
> **Grant Type**: Client Credentials
> **Scopes**: `uaa.none`
> **Authorities**: `uaa.resource`
> **Token expiry**: default (12 hours)

The `uaa.resource` authority allows the Eureka application to access the token verification endpoints on UAA. The client is created by the p-spring-cloud-services-worker client at provision time. The client ID and client secret are made available to the Eureka application via environment variables set at provision time. The credentials are the same as the corresponding client in the UAA Identity Zone.

Circuit Breaker Dashboard Service Instances

app hystrix-{guid}

The Hystrix application is one of the two backing applications for Circuit Breaker Dashboard service instances. The GUID in the application name is the service instance ID. This application is derived from the Netflix Hystrix Dashboard.

Entry Points

Hystrix Dashboard

The Hystrix Dashboard requires the typical Dashboard SSO flow. The service instance ID used in the permission check is supplied by an environment variable set at provision time by the Worker. The service instance permission check is cached in the same manner as the checks done by the service broker.

Actuator Endpoints

Actuator endpoints require the same Actuator SSO flow used by the Service Broker.

External Dependencies

The Turbine App

The Hystrix Dashboard UI uses an EventSource in the browser to listen to Server Sent Events emitted by the Turbine application. Because the Turbine application's origin differs from the Hystrix application, and EventSources do not support CORS, the Hystrix application must handle the EventSource request and proxy this request to the Turbine application.

The Turbine application must authenticate this request, so the Hystrix application includes the token in the proxy request. The proxy request is handled on Hystrix via the endpoint `/proxy.stream?origin=[turbine url]`. This endpoint on open-source Hystrix can be used as an open proxy, so to protect the token from being leaked, the Turbine URL in the origin query parameter must match the `TURBINE_URL` environment variable of the Hystrix application. This variable is set at provision time, always begins with `https://`, and can only be modified by the Operator.

UAA

The Hystrix application accesses the `/token_key` endpoint on UAA to retrieve the token verification key. This key material is used to verify the JWT signature of the token in order to authenticate the request.

The Cloud Controller

The Hystrix application communicates to the CC via HTTPS to perform permission checks using the current user's token, as described in the Entry Points section, and to derive URIs for UAA. The URI to the CC is set by the Worker at provision time in the application's environment variables, under the name `CF_TARGET`. The environment variable can only be modified by the Operator.

OAuth Clients

hystrix-{guid}

> **Identity Zone**: UAA
> **Grant Type**: Authorization Code
> **Scopes**: `openid`, `cloud_controller.read`, `cloud_controller_service_permissions.read`
> **Authorities**: `uaa.resource`
> **Token expiry**: default (12 hours)

This client is used for SSO with UAA. The scopes allow the Hystrix application to access the Cloud Controller API on the user's behalf, and are auto-approved. The `uaa.resource` authority allows the Hystrix application to access the token verification endpoints on UAA. The client is created by the p-spring-cloud-services-worker client at provision time. The client ID and client secret are made available to the Hystrix application via environment variables set at provision time.

app turbine-{guid}

The Turbine application is the other backing application for Circuit Breaker Dashboard service instances. The GUID in the application name is the service instance ID. This application is derived from Netflix Turbine, which aggregates Hystrix AMQP messages and emits them as a Server Sent Event stream.

Entry Points

GET /turbine.stream

This emits the Server Sent Event stream and is the only HTTP-based entry point. To authenticate the request, the Turbine application uses the Authorization header of the incoming request (containing the OAuth 2 Bearer token) to make a request to the CC API to check permissions on the service instance being accessed, as documented here. The service instance ID used in the permission check is supplied by an environment variable set at provision time by the Worker. This check is done once per SSE request, and because there is no session involved, it is not cached. However, SSE requests are kept alive until the browser window is closed, so the permission check will happen infrequently.

Hystrix AMQP messages

The Turbine application listens for AMQP messages posted by applications bound to the Circuit Breaker Dashboard service instance. Applications bound to the Circuit Breaker Dashboard receive credentials to the p-rabbitmq service instance in order to post these messages. All bound applications receive the same credentials.

External Dependencies

p-rabbitmq

As described earlier, bound applications use an instance of p-rabbitmq to post circuit breaker metrics. The Turbine application listens to these messages, aggregates the metrics, and emits a Server Sent Event stream. The credentials for the p-rabbitmq service instance are provided to the Turbine application though service instance binding. These same credentials are provided to applications bound to the Circuit Breaker Dashboard service instance, and would be visible to any user that is able to bind to the service instance. These credentials can be used for admin access to the RabbitMQ.

Since this RabbitMQ is only used for collecting and disseminating `@HystrixCommand` metrics from bound applications, one risk here is breaking the ability for metrics to be gathered and reported in the Hystrix dashboard. Doing this would not affect the operation of any application bound to the service instance.

The Cloud Controller

The Turbine application communicates to the CC via HTTPS to perform permission checks using the current user's token, as described in the section on the Server Sent Event stream. The URI to the CC is set by the Worker at provision time in the application's environment variables, under the name `CF_TARGET`. The environment variable can only be modified by the Operator.

Service Instance Upgrades

Service Instance Upgrade Steps

After an upgrade of the Spring Cloud Services product, follow the below steps to upgrade an individual service instance.

Important: If you have client applications which work with Spring Cloud Services 1.0.x service instances and are upgrading these service instances to 1.1.x, you must update your client applications to use the current version of the Spring Cloud Services client dependencies. See Client Application Changes in 1.1.0 below.

Important: After upgrading a Circuit Breaker Dashboard service instance from 1.0.x to 1.1.x, you must unbind, rebind, and restart any client applications which were bound to the instance. This is due to a change in how service instance credentials are managed.

Run `cf update-service -c '{"upgrade":true}' SERVICE_NAME`, where `SERVICE_NAME` is the name of a service instance:

```
$ cf update-service -c '{"upgrade": true}' config-server
Updating service instance config-server as admin...
OK

Update in progress. Use 'cf services' or 'cf service config-server' to check operation status.
```

As the output from the command suggests, you can use the `cf services` or `cf service` commands to check the status of the upgrade.

```
$ cf service config-server

Service instance: config-server
Service: p-config-server
Bound apps: cook
Tags:
Plan: standard
Description: Config Server for Spring Cloud Applications
Documentation url: http://docs.pivotal.io/spring-cloud-services/
Dashboard: https://spring-cloud-broker.apps.wise.com/dashboard/p-config-server/690f426b-9563-4d98-aa74-05ef3dea32c1

Last Operation
Status: update in progress
Message:
Started: 2016-06-22T16:13:27Z
Updated: 2016-06-22T16:13:27Z
```

When the upgrade is complete, `cf service SERVICE_NAME` will report a `Status` of `update succeeded`:

```
$ cf service config-server

Service instance: config-server
Service: p-config-server
Bound apps: cook
Tags:
Plan: standard
Description: Config Server for Spring Cloud Applications
Documentation url: http://docs.pivotal.io/spring-cloud-services/
Dashboard: https://spring-cloud-broker.apps.wise.com/dashboard/p-config-server/690f426b-9563-4d98-aa74-05ef3dea32c1

Last Operation
Status: update succeeded
Message:
Started: 2016-06-22T16:13:27Z
Updated: 2016-06-22T16:15:28Z
```

Client Application Changes in 1.1.0

The client dependencies for Spring Cloud Services were restructured in Spring Cloud Services version 1.1.0. In particular, the `spring-cloud-services-starter-parent` has been replaced with a `spring-cloud-services-dependencies` Maven BOM (Bill of Materials), which does not include the Spring Cloud or Spring Boot dependency BOMs.

If your client applications are using dependencies corresponding to a 1.0.x version of Spring Cloud Services, you must update them to use the 1.1.x BOM and include the other requisite dependencies. See the Client Dependencies topic for details on the current client dependencies.

Client Dependencies

Page last updated:

See below for information about the dependencies required for client applications using Spring Cloud Services service instances.

Include Spring Cloud Services Dependencies

Important: Ensure that the ordering of the Maven BOM dependencies listed below is preserved in your application's build file. Dependency resolution is affected in both Maven and Gradle by the order in which dependencies are declared.

To work with Spring Cloud Services service instances, your client application must include the `spring-cloud-services-dependencies` and `spring-cloud-dependencies` BOMs. Unless you are using the `spring-boot-starter-parent` or Spring Boot Gradle plugin, you must also specify the `spring-boot-dependencies` BOM as a dependency.

If using Maven, include in `pom.xml`:

```
<parent>
  <groupId>org.springframework.boot</groupId>
  <artifactId>spring-boot-starter-parent</artifactId>
  <version>1.3.5.RELEASE</version>
  <relativePath/> <!-- lookup parent from repository -->
</parent>

<dependencyManagement>
  <dependencies>
    <dependency>
      <groupId>io.pivotal.spring.cloud</groupId>
      <artifactId>spring-cloud-services-dependencies</artifactId>
      <version>1.1.2.RELEASE</version>
      <type>pom</type>
      <scope>import</scope>
    </dependency>
    <dependency>
      <groupId>org.springframework.cloud</groupId>
      <artifactId>spring-cloud-dependencies</artifactId>
      <version>Brixton.SR1</version>
      <type>pom</type>
      <scope>import</scope>
    </dependency>
  </dependencies>
</dependencyManagement>
```

If not using the `spring-boot-starter-parent`, include in the `<dependencyManagement>` block of `pom.xml`:

```
<dependencyManagement>
  <dependencies>
    <dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-dependencies</artifactId>
      <version>1.3.5.RELEASE</version>
      <type>pom</type>
      <scope>import</scope>
    </dependency>

    <!-- ... -->

  </dependencies>
</dependencyManagement>
```

If using Gradle, you will also need to use the Gradle dependency management plugin.

Include in `build.gradle`:

```
buildscript {
    repositories {
        mavenCentral()
    }
    dependencies {
        classpath("io.spring.gradle:dependency-management-plugin:0.5.6.RELEASE")
        classpath("org.springframework.boot:spring-boot-gradle-plugin:1.3.5.RELEASE")
    }
}

apply plugin: "java"
apply plugin: "spring-boot"
apply plugin: "io.spring.dependency-management"

dependencyManagement {
    imports {
        mavenBom "org.springframework.cloud:spring-cloud-dependencies:Brixton.SR1"
        mavenBom "io.pivotal.spring.cloud:spring-cloud-services-dependencies:1.1.2.RELEASE"
    }
}

repositories {
    maven {
        url "https://repo.spring.io/plugins-release"
    }
}
```

If not using the Spring Boot Gradle plugin, include in the `dependencyManagement` block of `build.gradle`:

```
dependencyManagement {
  imports {
    mavenBom "org.springframework.boot:spring-boot-dependencies:1.3.5.RELEASE"
  }
}
```

Config Server

Your application must declare `spring-cloud-services-starter-config-client` as a dependency.

If using Maven, include in `pom.xml`:

```
<dependencies>
  <dependency>
    <groupId>io.pivotal.spring.cloud</groupId>
    <artifactId>spring-cloud-services-starter-config-client</artifactId>
  </dependency>
</dependencies>
```

If using Gradle, include in `build.gradle`:

```
dependencies {
  compile("io.pivotal.spring.cloud:spring-cloud-services-starter-config-client")
}
```

Service Registry

Your application must declare `spring-cloud-services-starter-service-registry` as a dependency.

If using Maven, include in `pom.xml`:

```
<dependencies>
  <dependency>
    <groupId>io.pivotal.spring.cloud</groupId>
    <artifactId>spring-cloud-services-starter-service-registry</artifactId>
  </dependency>
</dependencies>
```

If using Gradle, include in `build.gradle`:

```
dependencies {
  compile("io.pivotal.spring.cloud:spring-cloud-services-starter-service-registry")
}
```

Circuit Breaker Dashboard

Your application must declare `spring-cloud-services-starter-circuit-breaker` as a dependency.

If using Maven, include in `pom.xml`:

```
<dependencies>
  <dependency>
    <groupId>io.pivotal.spring.cloud</groupId>
    <artifactId>spring-cloud-services-starter-circuit-breaker</artifactId>
  </dependency>
</dependencies>
```

If using Gradle, include in `build.gradle`:

```
dependencies {
  compile("io.pivotal.spring.cloud:spring-cloud-services-starter-circuit-breaker")
}
```

Troubleshooting Client Applications

See below for information about troubleshooting problems in client applications which are bound to Spring Cloud Services service instances.

“Can’t contact any eureka nodes - possibly a security group issue?”

A client application bound to a Service Registry service instance may log an error such as the following:

```
2015-10-01T11:33:38.43-0500 [App/0]      OUT 2015-10-01 16:33:38.433  WARN 29 ---
[           main] com.netflix.discovery.DiscoveryClient    : Action: Refresh  =>
returned status of 401 from https://eureka-aa9d8079f0f3.example.com/eureka/apps/
2015-10-01T11:33:38.43-0500 [App/0]      OUT 2015-10-01 16:33:38.438 ERROR 29 ---
[           main] com.netflix.discovery.DiscoveryClient    : Can't get a response from
https://eureka-aa9d8079f0f3.example.com/eureka/apps/
2015-10-01T11:33:38.43-0500 [App/0]      OUT Can't contact any eureka nodes - possibly a
security group issue?
2015-10-01T11:33:38.43-0500 [App/0]      OUT java.lang.RuntimeException: Bad status: 401
2015-10-01T11:33:38.43-0500 [App/0]      OUT    at
com.netflix.discovery.DiscoveryClient.makeRemoteCall(DiscoveryClient.java:1155)
```

If your PCF environment is using a self-signed certificate (such as a certificate generated in Elastic Runtime), you must set the `CF_TARGET` environment variable on your application to the API endpoint of Elastic Runtime. See the Add Self-Signed SSL Certificate to JVM Truststore section of the Writing Client Applications topic in the Service Registry documentation.

“sun.security.validator.ValidatorException: PKIX path building failed”

If you encounter the following exception:

```
sun.security.validator.ValidatorException: PKIX path building failed:
sun.security.provider.certpath.SunCertPathBuilderException: unable to find valid
certification path to requested target
```

If your PCF environment is using self-signed certificates, make sure that you have set the `CF_TARGET` environment variable on the application to the Elastic Runtime API endpoint as described in the Add Self-Signed SSL Certificate to JVM Truststore section of the Writing Client Applications topic in the Service Registry documentation.

Release Notes for Spring Cloud® Services on Pivotal Cloud Foundry

Release notes for Spring Cloud Services for Pivotal Cloud Foundry

Migrating from 1.0.x

For each client application, you must:

- Update the build file to use the new versions of the Spring Cloud Services client dependencies (see Client Dependencies)
- Update the build file to use the Maven BOM dependencies for Spring Boot and Spring Cloud (see Client Dependencies)

1.1.34

Release Date: 27th June 2018

Enhancements included in this release:

- The stemcell has been updated to 3468.51. This resolves the following issues:
  - [USN-3658-1]: procps-ng vulnerabilities
  - [USN-3675-1]: GnuPG vulnerabilities
  - [USN-3676-2]: Linux kernel (Xenial HWE) vulnerabilities
  - [USN-3686-1]: file vulnerabilities
  - [USN-3684-1]: Perl vulnerability

1.1.33

Release Date: 4th June 2018

Enhancements included in this release:

- The stemcell has been updated to 3468.46. This resolves the following issues:
  - [USN-3643-1]: Wget vulnerability
  - [USN-3648-1]: curl vulnerabilities
  - [USN-3654-2]: Linux kernel (Xenial HWE) vulnerabilities

1.1.32

Release Date: 10th May 2018

Enhancements included in this release:

- The stemcell has been updated to 3468.42. This resolves the following issues:
  - [USN-3641-1]: Linux kernel vulnerabilities
  - [USN-3631-2]: Linux kernel (Xenial HWE) vulnerabilities
  - [USN-3628-1]: OpenSSL vulnerability
  - [USN-3624-1]: Patch vulnerabilities
  - [USN-3625-1]: Perl vulnerabilities

1.1.31

Release Date: 17th April 2018

Enhancements included in this release:

- The stemcell has been updated to 3468.30. This resolves the following issues:
  - [USN-3619-2]: Linux kernel (Xenial HWE)
  - [USN-3611-1]: OpenSSL
  - [USN-3610-1]: ICU

1.1.30

Release Date: 28th March 2018

Enhancements included in this release:

- The stemcell has been updated to 3468.28. This resolves the following issues:
  - [USN-3586-1]: DHCP
  - [USN-3584-1]: sensible-utils
  - [USN-3598-1]: curl

1.1.29

Release Date: 26th February 2018

Enhancements included in this release:

- The stemcell has been updated to 3468.25. This resolves the following issues:
  - [USN-3554-1]: curl vulnerabilities
  - [USN-3543-1]: rsync vulnerabilities
  - [USN-3547-1]: Libtasn1 vulnerabilities
  - [USN-3582-2]: Linux kernel (Xenial HWE) vulnerabilities

1.1.28

Release Date: 24th January 2018

Enhancements included in this release:

- The stemcell has been updated to 3445.24. This resolves the following issues:
  - [USN-3540-2]: Linux kernel (Xenial HWE) vulnerabilities

1.1.27

Release Date: 19th January 2018

Enhancements included in this release:

- The stemcell has been updated to 3445.23. This resolves the following issues:
  - [USN-3534-1]: GNU C Library vulnerabilities

1.1.26

Release Date: 11th January 2018

Enhancements included in this release:

- The stemcell has been updated to 3445.22. This resolves the following issues:
  - [USN-3522-2]: Linux (Xenial HWE) vulnerability
  - [USN-3522-4]: Linux kernel (Xenial HWE) regression

1.1.25

Release Date: 11th December 2017

Enhancements included in this release:

- The stemcell has been updated to 3445.19. This resolves the following issues:
  - [USN-3505-1]: Linux firmware vulnerabilities

1.1.24

Release Date: 30th November 2017

Enhancements included in this release:

- The previous release used an incorrect version of the stemcell. This release corrects that. The stemcell has been updated to 3445.17.

1.1.23

Release Date: 2nd November 2017

Enhancements included in this release:

- The stemcell has been updated to 3445.16.

1.1.21

Release Date: 18th August 2017

Enhancements included in this release:

- The stemcell has been updated to 3363.31. This resolves the following issues:
  - [USN-3392-2]: Linux kernel (Xenial HWE) regression

1.1.20

Release Date: 15th August 2017

Enhancements included in this release:

- The stemcell has been updated to 3363.30. This resolves the following issues:
  - [USN-3385-2]: Linux kernel (Xenial HWE) vulnerabilities

1.1.19

Release Date: 6th August 2017

Enhancements included in this release:

- The stemcell has been updated to 3363.29. This resolves the following issues:
  - [USN-3378-2]: Linux kernel (Xenial HWE) vulnerabilities

1.1.18

Release Date: 21st June 2017

Enhancements included in this release:

- The stemcell has been updated to 3363.26. This resolves the following issues:
  - [USN-3334-1]: Linux kernel (Xenial HWE) vulnerabilities

1.1.17

Release Date: 5th June 2017

Enhancements included in this release:

- The stemcell has been updated to 3363.25. This resolves the following issues:
  - [USN-3304-1]: Sudo vulnerability

1.1.16

Release Date: 25th May 2017

Enhancements included in this release:

- The stemcell has been updated to 3363.24. This resolves the following issues:
  - [USN-3291-3]: Linux kernel (Xenial HWE) vulnerabilities

1.1.15

Release Date: 27th April 2017

Enhancements included in this release:

- The stemcell has been updated to 3363.20. This resolves the following issues:
  - [USN-3265-2]: Linux kernel (Xenial HWE) vulnerabilities

1.1.14

Release Date: 31st March 2017

Enhancements included in this release:

- The stemcell has been updated to 3363.14. This resolves the following issues:
  - [USN-3249-2]: Linux kernel (Xenial HWE) vulnerability

1.1.13

Release Date: 10th March 2017

Enhancements included in this release:

- The stemcell has been updated to 3263.21. This resolves the following issues:
  - [USN-3220-2]: Linux kernel (Xenial HWE) vulnerability

1.1.12

Release Date: 28th February 2017

Enhancements included in this release:

- The stemcell has been updated to 3263.20. This resolves the following issues:
  - [USN-3208-2]: Linux kernel (Xenial HWE) vulnerabilities

1.1.11

Release Date: 30th January 2017

Enhancements included in this release:

- The stemcell has been updated to 3263.17. This resolves the following issues:
  - [USN-3161-2]: Linux kernel (Xenial HWE) vulnerabilities
  - [USN-3169-2]: Linux kernel (Xenial HWE) vulnerabilities
  - [USN-3172-1]: Bind vulnerabilities

1.1.10

Release Date: 14th December 2016

Enhancements included in this release:

- The stemcell has been updated to 3263.13. This resolves the following issues:
  - [USN-3156-1]: APT vulnerability

1.1.9

Release Date: 7th December 2016

Enhancements included in this release:

- The stemcell has been updated to 3263.12. This resolves the following issues:
  - [USN-3151-2]: Linux kernel (Xenial HWE) vulnerability

1.1.8

Release Date: 21st October 2016

Enhancements included in this release:

- The stemcell has been updated to 3233.3. This resolves the following issues:
  - [USN-3106-2]: Linux kernel (Xenial HWE) vulnerability

1.1.7

Release Date: 12th October 2016

Enhancements included in this release:

- The stemcell has been updated to 3233.2 for stability and bug fixes.

1.1.6

Release Date: 6th October 2016

Enhancements included in this release:

- The stemcell has been updated to 3233.1 as an upgrade to Linux version 4.4 kernel and to enable future upgrades.

1.1.4

Release Date: 28th September 2016

Enhancements included in this release:

- The stemcell has been updated to 3232.21. This resolves the following issues:
  - [USN-3087-2]: OpenSSL regression

1.1.3

Release Date: 8th September 2016

This release includes a Cloud Foundry component update.

Features included in this release:

- The Cloud Foundry Command Line Interface tool (cf CLI) used in errands has been upgraded to version 6.21.1 and is now configured to allow for long DNS resolution times.

1.1.2

Release Date: 24th August 2016

This release updates the stemcell and adds enhancements to the Config Server and Circuit Breaker Dashboard services. It also contains bug fixes.

Features included in this release:

- The stemcell has been updated to 3232.17. This resolves the following issues:
  - [USN-3064-1]: GnuPG vulnerability

Enhancements included in this release:

- Config Server support for placeholders in repository URIs has been improved.
- Config Server can now be configured to clone configuration source repositories on startup (as opposed to the default behavior of cloning a repository when configuration is first requested from the associated configuration source). See the table of general configuration parametersin the Creating an Instance topic of the Config Server documentation for more information.
- Circuit Breaker Dashboard's Spring Cloud Stream configuration now uses all URIs provided for the associated RabbitMQ for Pivotal Cloud Foundry service instance.
- The tile install and uninstall processes are now more resilient to errors encountered during the relevant errands.

Fixes included in this release:

- If the service broker worker fails to update a service instance when the service broker receives a provision or update request, the request to the service broker will now time out and the service instance status will be changed from PENDING to FAILED.
- Applications unbound from a Service Registry service instance will no longer remain in the service instance's registry and will be removed from that registry shortly after being unbound from the service instance.
- Fixed a problem where the service broker's authentication to the Cloud Controller would expire if the broker remained inactive for a long period of time.

1.1.1

Release Date: 1st July 2016

Features included in this release:

- The stemcell has been updated to 3232.12. This resolves the following issues:
  - [USN-3020-1]: Linux kernel (Vivid HWE) vulnerabilities

1.1.0

Release Date: 28th June 2016

Important: Your client applications which work with Spring Cloud Services 1.0.x service instances must be updated in order to work with 1.1.0 service instances. See Migrating from 1.0.x.

Features included in this release:

- Spring Cloud Services now supports Pivotal Cloud Foundry versions 1.6 and later.

- Service instances are now based on Spring Cloud Brixton.SR1, and client applications can use Spring Boot 1.3.x and Spring Cloud Brixton.SR1. For more information about client application dependencies, see Client Dependencies.
- The service broker now supports asynchronous service operations. For more information, see the The Service Broker section of the Operator Information.
- Operators can now explicitly choose the Java buildpack that will be used to deploy service instances. For more information, see the Set Buildpack for Service Instances section of the Operator Information.
- Operators can now upgrade either individual service instances or all non-upgraded service instances directly from the Service Instances dashboard. For more information, see the The Service Instances Dashboard section of the Operator Information.
- Upgrades of service instances now result in zero downtime for the service instances. For more information about upgrading service instances, see Service Instance Upgrades.
- Updates to Config Server settings now result in zero downtime for the Config Server service instance. For more information about updating a Config Server instance's settings, see Updating an Instance in the Config Server documentation.
- Config Server can now access a Git repository that uses self-signed SSL certificates with HTTPS. For more information about supported configuration sources, see The Config Server in the Config Server documentation.
- Config Server can now access a Git repository via a proxy server when using HTTP or HTTPS.
- Config Server can now access a Git repository using the Git or SSH protocols in addition to HTTP and HTTPS.
- Config Server can now be created with or updated to use multiple Git repositories as configuration sources.
- Config Server and Service Registry can now operate in high-availability mode, with a set count of instances to provision being specified when creating or updating a service instance. For more information, see Creating an Instance and Updating an Instance in the Config Server documentation and Creating an Instance and Updating an Instance in the Service Registry documentation.

Enhancements included in this release:

- The operator Service Instances dashboard now displays the service keys bound to a service instance, in addition to its bound applications. For more information about the Service Instances dashboard, see the The Service Instances Dashboard section of the Operator Information.
- Dashboards for individual service instances now display the username of the logged-in user and provide a link to log out.
- Config Server service instances are now exclusively configured using provision and update parameters given to the Cloud Foundry Command Line Interface tool (cf CLI), and the Config Server's dashboard now displays the service instance's configuration. For more information, see Creating an Instance, Updating an Instance, and Using the Dashboard in the Config Server documentation.
- When creating a Circuit Breaker Dashboard service instance, the service broker now performs tasks in parallel for faster provisioning.

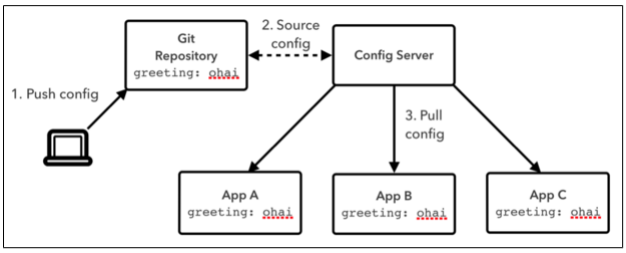
Known issues:

- Config Server currently does not support use of a private Git repository accessed via an authenticated proxy server as a configuration source. For more information, see Creating an Instance or Updating an Instance in the Config Server documentation.
- When upgrading a Circuit Breaker Dashboard instance from 1.0.x to 1.1.0, running applications must be unbound, rebound, and restarted, due to a change in how credentials are managed.

Config Server for Pivotal Cloud Foundry

Overview

Config Server for Pivotal Cloud Foundry (PCF) is an externalized application configuration service, which gives you a central place to manage an application's external properties across all environments. As an application moves through the deployment pipeline from development to test and into production, you can use Config Server to manage the configuration between environments and be certain that the application has everything it needs to run when you migrate it. Config Server easily supports labelled versions of environment-specific configurations and is accessible to a wide range of tooling for managing the content.



The concepts on both client and server map identically to the Spring `Environment` and `PropertySource` abstractions. They work very well with Spring applications, but can be applied to applications written in any language. The default implementation of the server storage backend uses Git.

Config Server for Pivotal Cloud Foundry is based on Spring Cloud Config Server. For more information about Spring Cloud Config and about Spring configuration, see Additional Resources.

Refer to the "Cook" sample application to follow along with code in this section.

Creating an Instance

Page last updated:

You can create a Config Server service instance using either the Cloud Foundry Command Line Interface tool (cf CLI) or Pivotal Cloud Foundry (PCF) Apps Manager (you cannot configure a service instance using Apps Manager).

Using the cf CLI

Begin by targeting the correct org and space.

```
$ cf target -o myorg -s development

API endpoint:   https://api.cf.wise.com (API version: 2.43.0)
User:           user
Org:            myorg
Space:          development
```

You can view plan details for the Config Server product using `cf marketplace -s`.

```
$ cf marketplace
Getting services from marketplace in org myorg / space development as user...
OK

service                     plans          description
p-circuit-breaker-dashboard   standard       Circuit Breaker Dashboard for Spring Cloud Applications
p-config-server               standard       Config Server for Spring Cloud Applications
p-mysql                       100mb-dev      MySQL service for application development and testing
p-rabbitmq                    standard       RabbitMQ is a robust and scalable high-performance multi-protocol messaging broker.
p-service-registry            standard       Service Registry for Spring Cloud Applications

TIP:  Use 'cf marketplace -s SERVICE' to view descriptions of individual plans of a given service.

$ cf marketplace -s p-config-server
Getting service plan information for service p-config-server as user...
OK

service plan   description     free or paid
standard       Standard Plan   free
```

Create the service instance using `cf create-service`, using the `-c` flag to provide a JSON object that specifies the configuration parameters. Parameters used to configure configuration sources are part of a JSON object called `git`, as in `{"git": { "uri": "http://example.com/config" } }`. For more information on the purposes of these fields, see the The Config Server topic.

General parameters used to configure the Config Server's default configuration source are listed below.

Parameter	Function
`uri`	The URI (`http://`, `https://`, or `ssh://`) of a repository that can be used as the default configuration source
`label`	The default "label" that can be used with the default repository if a request is received without a label (e.g., if the `spring.cloud.config.label` property is not set in a client application)
`searchPaths`	A pattern used to search for configuration-containing subdirectories in the default repository
`cloneOnStart`	Whether the Config Server should clone the default repository when it starts up (by default, the Config Server will only clone the repository when configuration is first requested from the repository). Valid values are `true` and `false`
`username`	The username used to access the default repository (if protected by HTTP Basic authentication)
`password`	The password used to access the default repository (if protected by HTTP Basic authentication)

Important: If you set `cloneOnStart` to `true` for a service instance that uses a repository which is secured with HTTP Basic authentication, you must set the `username` and `password` at the same time as you set `cloneOnStart`. Otherwise, the Config Server will be unable to access the repository and the service instance may fail to initialize.

The `uri` setting is required; you cannot define a Config Server configuration source without including a `uri`.

The default value of the `label` setting is `master`. You can set `label` to a branch name, a tag name, or a specific Git commit hash.

To set `label` to point to the `develop` branch of a repository, you might configure settings as shown in the following JSON:

```
'{"git": { "uri": "https://github.com/myorg/config-repo", "label": "develop" } }'
```

To set `label` to point to the `v1.1` tag in a repository, you might configure settings as shown in the following JSON:

```
'{"git": { "uri": "https://github.com/myorg/config-repo", "label": "v1.1" } }'
```

Within a client application, you can override the Config Server's `label` setting by setting the `spring.cloud.config.label` property (for example, in `bootstrap.yml`).

```
spring:
  cloud:
    config:
      label: v1.2
```

Other parameters accepted for the Config Server are listed below.

Parameter	Function	Example
`count`	The number of nodes to provision: 1 by default, more for running in high-availability mode	`'{"count": 3}'`
`upgrade`	Whether to upgrade the instance	`'{"upgrade": true}'`

To create an instance, specifying settings for the configuration sources, that the default configuration source Git repository should be cloned when the Config Server starts up, and that three nodes should be provisioned:

```
$ cf create-service -c '{"git": { "uri": "https://github.com/spring-cloud-services-samples/config-repo", "cloneOnStart": "true", "repos": { "cook": { "pattern": "cook*", "uri": "https://github.com/sp
Creating service instance config-server in org myorg / space development as user...
OK

Create in progress. Use 'cf services' or 'cf service config-server' to check operation status.
```

As the command output suggests, you can use the `cf services` or `cf service` commands to check the status of the service instance. When the service instance is ready, the `cf service` command will give a status of `create succeeded`:

```
$ cf service config-server

Service instance: config-server
Service: p-config-server
Bound apps:
Tags:
Plan: standard
Description: Config Server for Spring Cloud Applications
Documentation url: http://docs.pivotal.io/spring-cloud-services/
Dashboard: https://spring-cloud-broker.apps.wise.com/dashboard/p-config-server/9281c950-9b07-495e-9af4-f9fbd277037d

Last Operation
Status: create succeeded
Message:
Started: 2016-06-24T21:57:21Z
Updated: 2016-06-24T21:59:24Z
```

Important: The `cf service` and `cf services` commands may report a `create succeeded` status even if the Config Server cannot initialize using the provided settings. For example, given an invalid URI for a configuration source, the service instance may still be created and have a `create succeeded` status.

If the service instance does not appear to be functioning correctly, you can visit its dashboard to double-check that the provided settings are valid and accurate. See the Using the Dashboard topic.

Note: You may notice a discrepancy between the status given for a service instance by the cf CLI (e.g., by the `cf service` command) versus that shown on the Service Instances dashboard. The dashboard is updated frequently (close to real-time); the status retrieved by the cf CLI is not updated as frequently and may take time to match the dashboard.

SSH Repository Access

You can configure a Config Server configuration source so that the Config Server accesses it using the Secure Shell (SSH) protocol. To do so, you must specify a URI using the `ssh://` URI scheme or the Secure Copy Protocol (SCP) style URI format, and you must supply a private key. You may also supply a host key with which the server will be identified. If you do not provide a host key, the Config Server will not verify the host key of the configuration source's server.

A SSH URI must include a username, host, and repository path. This might be specified as shown in the following JSON:

```
'{"git": { "uri": "ssh://git@github.com/spring-cloud-services-samples/cook.git"} }'
```

An equivalent SCP-style URI might be specified as shown in the following JSON:

```
'{"git": { "uri": "git@github.com:spring-cloud-services-samples/cook-config.git"} }'
```

The parameters used to configure SSH for a Config Server configuration source's URI are listed below.

Parameter	Function
`hostKey`	The host key of the Git server. If you have connected to the server via git on the command line, this is in your `.ssh/known_hosts`. Do not include the algorithm prefix; this is specified in `hostKeyAlgorithm`. (Optional.)
`hostKeyAlgorithm`	The algorithm of `hostKey`: one of "ssh-dss", "ssh-rsa", "ecdsa-sha2-nistp256", "ecdsa-sha2-nistp384", and "ecdsa-sha2-nistp521". (Required if supplying `hostKey`.)
`privateKey`	The private key that identifies the Git user, with all newline characters replaced by `\n`. Passphrase-encrypted private keys are not supported.

To create a Config Server service instance that uses SSH to access a configuration source, allowing for host key verification, run:

```
$ cf create-service p-config-server standard config-server -c '{"git": { "uri": "ssh://git@github.com/spring-cloud-services-samples/cook.git", "hostKey": "AAAAB3NzaC1yc2EAAAABIwAAAQ
```

To create a Config Server service instance that uses SSH to access a configuration source, without host key verification, run:

```
$ cf create-service p-config-server standard config-server -c '{"git": { "uri": "ssh://git@github.com/spring-cloud-services-samples/cook.git", "privateKey": "-----BEGIN RSA PRIVATE KEY-----
```

Multiple Repositories

You can configure a Config Server service instance to use multiple configuration sources, which will be used only for specific applications or for applications which are using specific profiles. To do so, you must provide parameters in repository objects within the `git.repos` JSON object. Most parameters set in the `git` object for the default configuration source are also available for specific configuration sources and can be set in repository objects within the `git.repos` object.

Each repository object in the `git.repos` object has a name. In the repository specified in the following JSON, the name is “cookie”:

```
'{ "git": { "repos": { "cookie": { "uri": "https://github.com/spring-cloud-services-samples/cook-config" } } } }'
```

Each repository object also has a `pattern`, which is a comma-separated list of application and profile names separated with forward slashes (`/`, as in `app/profile`) and potentially including wildcards (`*`, as in `app*/profile*`). If you do not supply a pattern, the repository object’s name will be used as the pattern. In the repository specified in the following JSON, the pattern is `co*/dev*` (matching any application whose name begins with `co` and which is using a profile whose name begins with `dev`), and the default pattern would be `cookie`:

```
'{"git": { "repos": { "cookie": { "pattern": "co*/dev*", "uri": "https://github.com/spring-cloud-services-samples/cook-config" } } } }'
```

For more information about the pattern format, see “Pattern Matching and Multiple Repositories” in the Spring Cloud Config documentation.

The parameters used to configure specific configuration sources for the Config Server are listed below.

Parameter	Function
`repos."name"`	A repository object, containing repository fields
`repos."name".pattern`	A pattern for the names of applications that store configuration from this repository (if not supplied, will be `"name"`)
`repos."name".uri`	The URI (`http://`, `https://`, or `ssh://`) of this repository
`repos."name".label`	The default “label” to use with this repository if a request is received without a label (e.g., if the `spring.cloud.config.label` property is not set in a client application)
`repos."name".searchPaths`	A pattern used to search for configuration-containing subdirectories in this repository
`repos."name".cloneOnStart`	Whether the Config Server should clone this repository when it starts up (by default, the Config Server will only clone the repository when configuration is first requested from the repository). Valid values are `true` and `false`
`repos."name".username`	The username used to access this repository (if protected by HTTP Basic authentication)
`repos."name".password`	The password used to access this repository (if protected by HTTP Basic authentication)
`repos."name".hostKey`	The host key used by the Config Server to access this repository (if accessing via SSH). See theSSH Repository Access section for more information
`repos."name".hostKeyAlgorithm`	The algorithm of `hostKey`: one of “ssh-dss”, “ssh-rsa”, “ecdsa-sha2-nistp256”, “ecdsa-sha2-nistp384”, and “ecdsa-sha2-nistp521”
`repos."name".privateKey`	The private key corresponding to `hostKey`, with all newline characters replaced by `\n`

Important: If you set `cloneOnStart` to `true` for a repository which is secured with HTTP Basic authentication, you must set the `username` and `password` at the same time as you set `cloneOnStart`. Otherwise, the Config Server will be unable to access the repository and the service instance may fail to initialize.

The `uri` setting is required; you cannot define a Config Server configuration source without including a `uri`.

The default value of the `label` setting is `master`. You can set `label` to a branch name, a tag name, or a specific Git commit hash.

To set `label` to point to the `develop` branch of a repository, you might configure the setting as shown in the following JSON:

```
'{"git": { "repos": { "cookie": { "uri": "https://github.com/myorg/config-repo", "label": "develop" } } } }'
```

To set `label` to point to the `v1.1` tag in a repository, you might configure the setting as shown in the following JSON:

```
'{"git": { "repos": { "cookie": { "uri": "https://github.com/myorg/config-repo", "label": "v1.1" } } } }'
```

Within a client application, you can override this `label` setting’s value by setting the `spring.cloud.config.label` property (for example, in `bootstrap.yml`).

```
spring:
  cloud:
    config:
      label: v1.2
```

To create a Config Server service instance with a default repository and a repository specific to an application named “cook”, run:

```
$ cf create-service p-config-server standard config-server -c '{"git": { "uri": "https://github.com/spring-cloud-services-samples/fortune-teller", "searchPaths": "configuration", "repos": { "cookie":
```

To create a Config Server service instance with a default repository and a repository specific to applications using the `dev` profile, run:

```
$ cf create-service p-config-server standard config-server -c '{"git": { "uri": "https://github.com/spring-cloud-services-samples/fortune-teller", "searchPaths": "configuration", "repos": { "cookie"
```

Placeholders in Repository URIs

The URIs for configuration source Git repositories can include a couple of special strings as placeholders:

- `{application}`: the name set in the `spring.application.name` property on an application
- `{profile}`: a profile listed in the `spring.profiles.active` property on an application

You can use these placeholders to (for example) set a single URI which maps one repository each to multiple applications that use the same Config Server, or to set a single URI which maps one repository each to multiple profiles.

Note: URI placeholders cannot be used with a repository that has the `cloneOnStart` setting set to `true`. See the listing for `cloneOnStart` in the table of general configuration parameters.

A repository URI that enables use of one repository per application might be expressed as shown in the following JSON. For an application named "cook", this would locate the repository named `cook-config`:

```
'{"git": { "uri": "https://github.com/spring-cloud-services-samples/{application}-config" } }'
```

A repository URI that enables use of one repository per profile might be expressed as shown in the following JSON. For an application using the `dev` profile, this would locate a repository named `config-dev`:

```
'{"git": { "uri": "https://github.com/spring-cloud-services-samples/config-{profile}" } }'
```

For more information about using placeholders, see "Placeholders in Git URI" in the Spring Cloud Config documentation.

To create a Config Server service instance with a repository URI that enables one repository per application, run:

```
$ cf create-service p-config-server standard config-server -c '{"git": { "uri": "https://github.com/spring-cloud-services-samples/{application}-config" } }'
```

To create a Config Server service instance with a repository URI that enables one repository per profile, run:

```
$ cf create-service p-config-server standard config-server -c '{"git": { "uri": "https://github.com/spring-cloud-services-samples/config-{profile}" } }'
```

HTTP(S) Proxy Repository Access

You can configure a Config Server service instance to access configuration sources using an HTTP or HTTPS proxy. To do so, you must provide proxy settings in either of the `git.proxy.http` or `git.proxy.https` JSON objects. You can set the proxy host and port, the proxy username and password (if applicable), and a list of hosts which the Config Server should access outside of the proxy.

Important: Config Server for Pivotal Cloud Foundry does not support use of a private Git repository accessed via an authenticated proxy server as a configuration source at this time.

Settings for an HTTP proxy are set in the `git.proxy.http` object. These might be set as shown in the following JSON:

```
'{"git": { "proxy": { "http": { "host": "proxy.wise.com", "port": "80" } } } }'
```

Settings for an HTTPS proxy are set in the `git.proxy.https` object. These might be set as shown in the following JSON:

```
'{"git": { "proxy": { "https": { "host": "secure.wise.com", "port": "443" } } } }'
```

The parameters used to configure HTTP or HTTPS proxy settings for the Config Server are listed below.

Parameter	Function
`proxy.http`	A proxy object, containing HTTP proxy fields
`proxy.http.host`	The HTTP proxy host
`proxy.http.port`	The HTTP proxy port
`proxy.http.nonProxyHosts`	The hosts to access outside the HTTP proxy
`proxy.http.username`	The username to use with an authenticated HTTP proxy
`proxy.http.password`	The password to use with an authenticated HTTP proxy
`proxy.https`	A proxy object, containing HTTPS proxy fields
`proxy.https.host`	The HTTPS proxy host
`proxy.https.port`	The HTTPS proxy port
`proxy.https.nonProxyHosts`	The hosts to access outside the HTTPS proxy (if `proxy.http.nonProxyHosts` is also provided, `http.nonProxyHosts` will be used instead of `https.nonProxyHosts`)

Parameter	Function
`proxy.https.username`	The username to use with an authenticated HTTPS proxy (if `proxy.http.username` is also provided, `http.username` will be used instead of `https.username`)
`proxy.https.password`	The password to use with an authenticated HTTPS proxy (if `proxy.http.password` is also provided, `http.password` will be used instead of `https.password`)

To create a Config Server service instance that uses an HTTP proxy to access configuration sources, run:

```
$ cf create-service p-config-server standard config-server -c '{"git": {"uri": "https://github.com/spring-cloud-services-samples/cook-config", "proxy": { "http": { "host": "proxy.wise.com", "port":
```

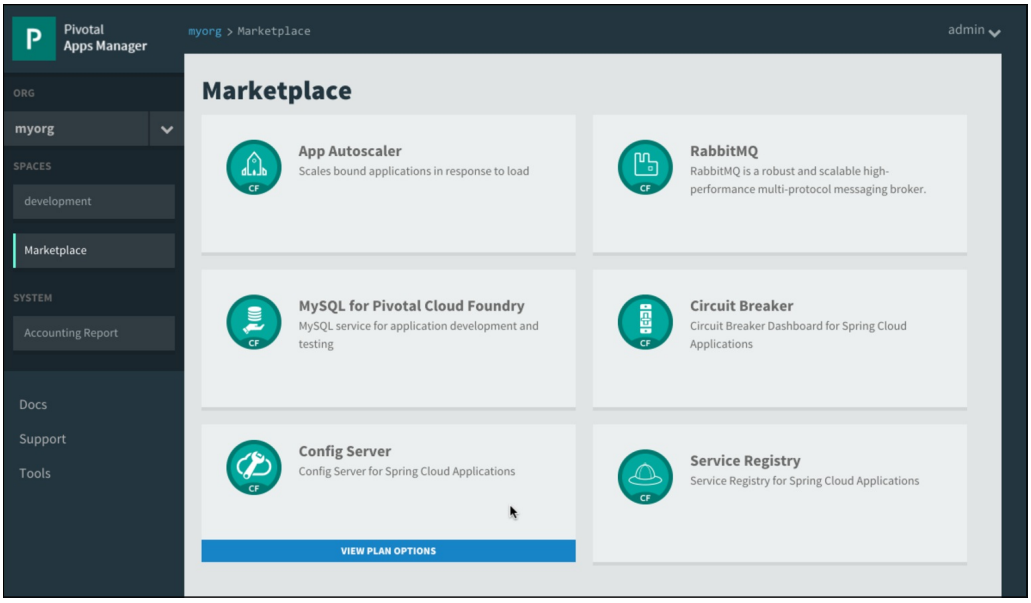
To create a Config Server service instance that uses an authenticated HTTPS proxy to access configuration sources, specifying that `example.com` should be accessed outside of the proxy, run:

```
$ cf create-service p-config-server standard config-server -c '{"git": {"uri": "https://github.com/spring-cloud-services-samples/cook-config", "proxy": { "https": { "host": "secure.wise.com", "port
```

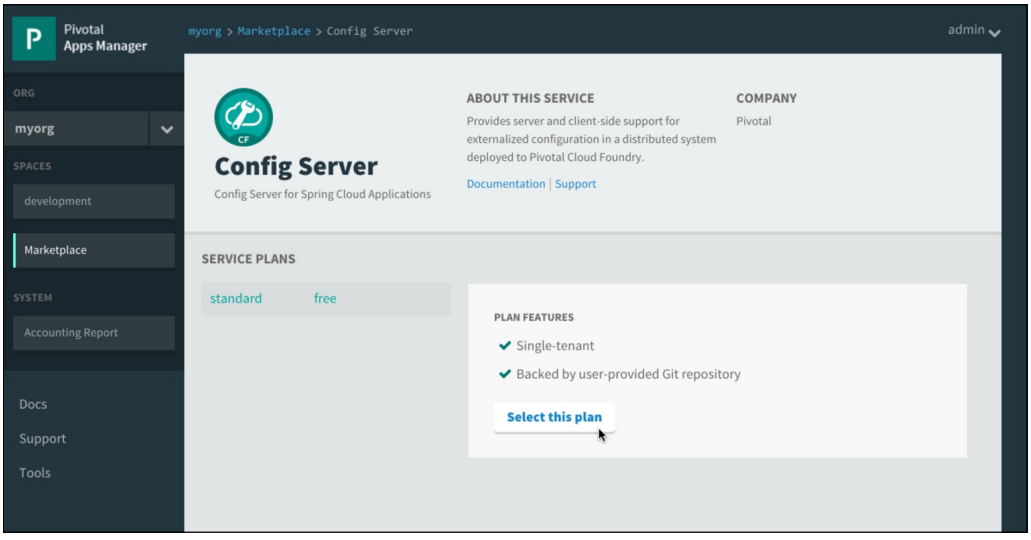
Using Apps Manager

Note: If you create a Config Server service instance using Apps Manager, you will need to use the cf CLI to update the service instance and provide settings (including one or more configuration sources) before the instance will be usable. For information on updating a Config Server service instance, see the Updating an Instance topic.

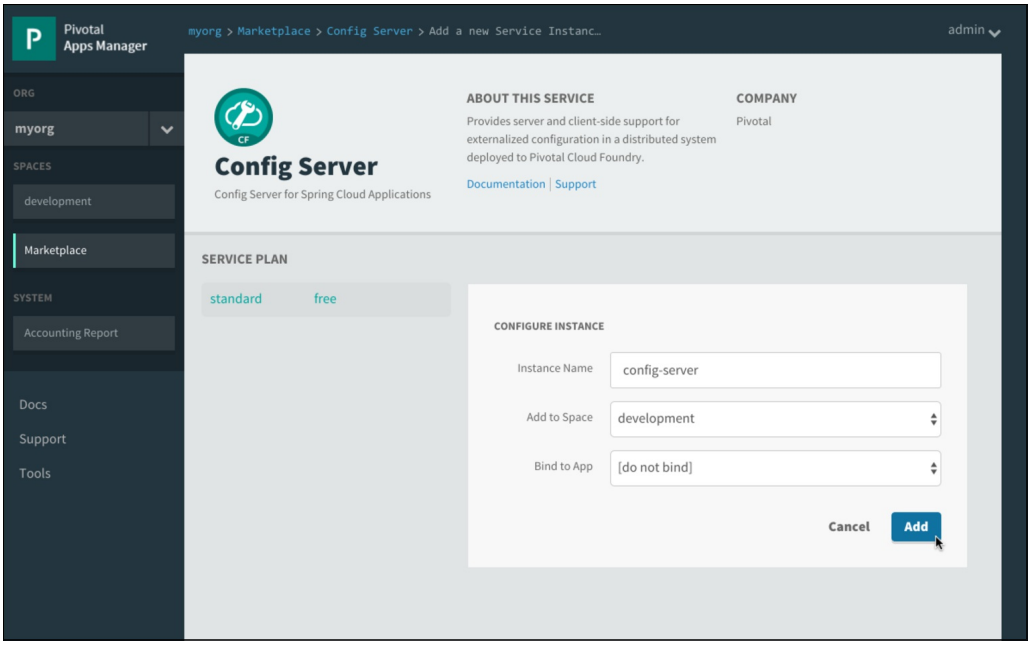
Log into Apps Manager as a Space Developer. In the Marketplace, select **Config Server**.



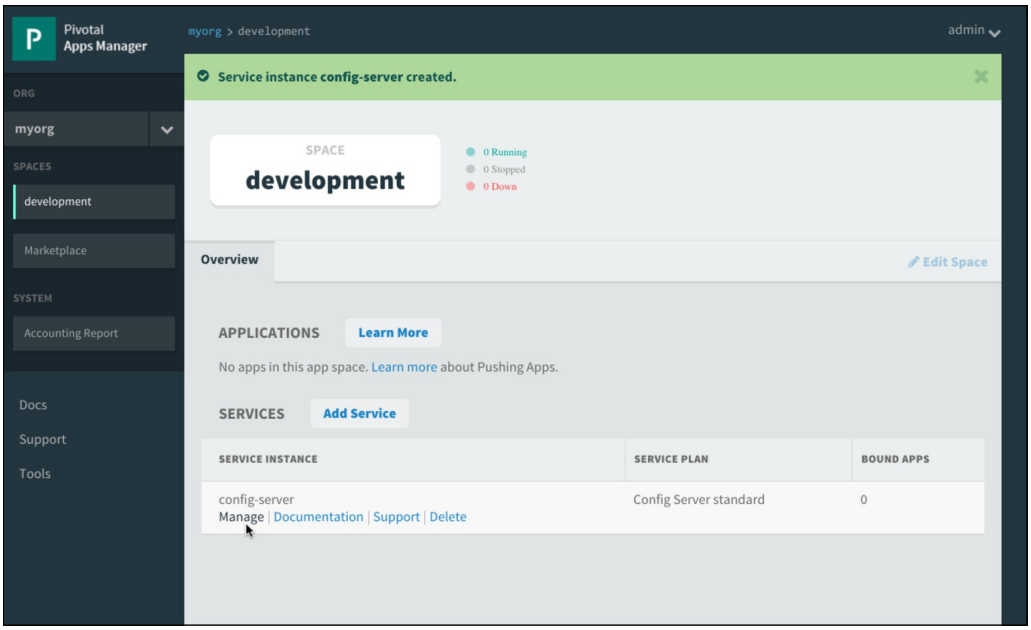
Select the desired plan for the new service instance.



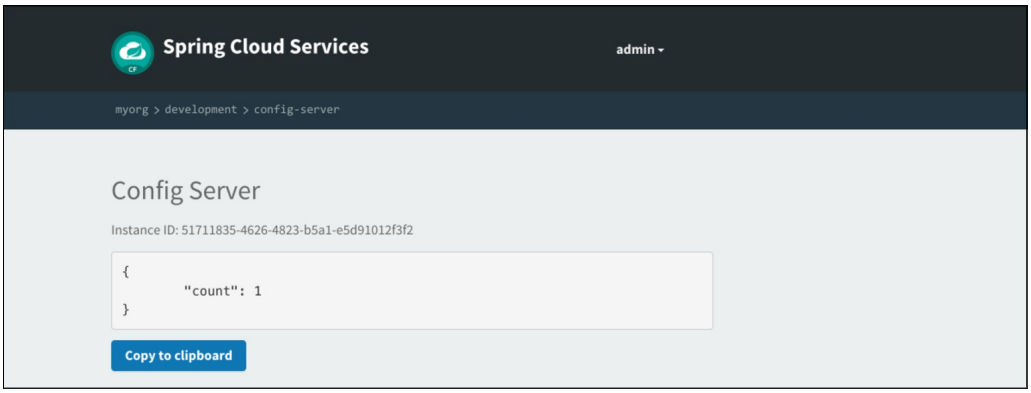
Provide a name for the service instance (for example, “config-server”). Click the **Add** button.



In the **Services** list, click the **Manage** link under the listing for the new service instance.



It may take a few minutes to provision the service instance; while it is being provisioned, you will see a “The service instance is initializing” message. When the instance is ready, its dashboard will load automatically.



The dashboard displays the current settings for the Config Server service instance. Before you can use this service instance, you must update it using the cf CLI to supply it with a configuration source. For information about updating a service instance to configure instance settings, see the Updating an Instance topic.

Updating an Instance

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You can update settings on a Config Server service instance using the Cloud Foundry Command Line Interface tool (cf CLI). The `cf update-service` command can be given a `-c` flag with a JSON object containing parameters used to configure the service instance.

To update a Config Server service instance's settings, target the org and space of the service instance:

```
$ cf target -o myorg -s development

API endpoint:   https://api.cf.wise.com (API version: 2.43.0)
User:           user
Org:            myorg
Space:          development
```

Then run `cf update-service SERVICE_NAME -c '{ "PARAMETER": "VALUE" }'`, where `SERVICE_NAME` is the name of the service instance, `PARAMETER` is a supported parameter, and `VALUE` is the value for the parameter. For information about supported parameters, see the next section.

Configuration Parameters

Parameters used to configure configuration sources are part of a JSON object called `git`, as in `{"git": { "uri": "http://example.com/config" } }`. For more information on the purposes of these fields, see the The Config Server topic.

General parameters used to configure the Config Server's default configuration source are listed below.

Parameter	Function
`uri`	The URI (`http://`, `https://`, or `ssh://`) of a repository that can be used as the default configuration source
`label`	The default "label" that can be used with the default repository if a request is received without a label (e.g., if the `spring.cloud.config.label` property is not set in a client application)
`searchPaths`	A pattern used to search for configuration-containing subdirectories in the default repository
`cloneOnStart`	Whether the Config Server should clone the default repository when it starts up (by default, the Config Server will only clone the repository when configuration is first requested from the repository). Valid values are `true` and `false`
`username`	The username used to access the default repository (if protected by HTTP Basic authentication)
`password`	The password used to access the default repository (if protected by HTTP Basic authentication)

Important: If you set `cloneOnStart` to `true` for a service instance that uses a repository which is secured with HTTP Basic authentication, you must set the `username` and `password` at the same time as you set `cloneOnStart`. Otherwise, the Config Server will be unable to access the repository and the service instance may fail to initialize.

The `uri` setting is required; you cannot define a Config Server configuration source without including a `uri`.

The default value of the `label` setting is `master`. You can set `label` to a branch name, a tag name, or a specific Git commit hash.

To set `label` to point to the `develop` branch of a repository, you might configure settings as shown in the following JSON:

```
'{"git": { "uri": "https://github.com/myorg/config-repo", "label": "develop" } }'
```

To set `label` to point to the `v1.1` tag in a repository, you might configure settings as shown in the following JSON:

```
'{"git": { "uri": "https://github.com/myorg/config-repo", "label": "v1.1" } }'
```

Within a client application, you can override the Config Server's `label` setting by setting the `spring.cloud.config.label` property (for example, in `bootstrap.yml`).

```
spring:
  cloud:
    config:
      label: v1.2
```

Other parameters accepted for the Config Server are listed below.

Parameter	Function	Example
`count`	The number of nodes to provision: 1 by default, more for running in high-availability mode	`'{"count": 3}'`
`upgrade`	Whether to upgrade the instance	`'{"upgrade": true}'`

To update a service instance, setting the configuration sources and specifying that the default configuration source Git repository should be cloned when the Config Server starts up, run:

```
$ cf update-service config-server -c '{"git": { "uri": "https://github.com/spring-cloud-services-samples/config-repo", "cloneOnStart": "true", "repos": { "cook": { "pattern": "cook*", "uri": "https:/
Updating service instance config-server as admin...
OK

Update in progress. Use 'cf services' or 'cf service config-server' to check operation status.
```

To update a service instance and set the count of instances for running in high-availability mode, run:

```
$ cf update-service config-server -c '{"count": 3}'
Updating service instance config-server as admin...
OK

Update in progress. Use 'cf services' or 'cf service config-server' to check operation status.
```

As the command output suggests, you can use the `cf services` or `cf service` commands to check the status of the service instance. When the update is complete, the `cf service` command will give a status of `update succeeded`:

```
$ cf service config-server

Service instance: config-server
Service: p-config-server
Bound apps:
Tags:
Plan: standard
Description: Config Server for Spring Cloud Applications
Documentation url: http://docs.pivotal.io/spring-cloud-services/
Dashboard: https://spring-cloud-broker.apps.wise.com/dashboard/p-config-server/e2615a44-66f5-4fda-9ddc-079af1db9ae4

Last Operation
Status: update succeeded
Message:
Started: 2016-06-24T21:11:53Z
Updated: 2016-06-24T21:13:59Z
```

Important: The `cf service` and `cf services` commands may report an `update succeeded` status even if the Config Server cannot initialize using the provided settings. For example, given an invalid URI for a configuration source, the service instance may still be restarted and have an `update succeeded` status.

If the service instance does not appear to be functioning correctly after an update, you can visit its dashboard to double-check that the provided settings are valid and accurate. See the Using the Dashboard topic.

The service instance is now updated and ready to be used. For information about using an application to access configuration values served by a Config Server service instance, see the Writing Client Applications topic.

SSH Repository Access

You can configure a Config Server configuration source so that the Config Server accesses it using the Secure Shell (SSH) protocol. To do so, you must specify a URI using the `ssh://` URI scheme or the Secure Copy Protocol (SCP) style URI format, and you must supply a private key. You may also supply a host key with which the server will be identified. If you do not provide a host key, the Config Server will not verify the host key of the configuration source's server.

A SSH URI must include a username, host, and repository path. This might be specified as shown in the following JSON:

```
'{"git": { "uri": "ssh://git@github.com/spring-cloud-services-samples/cook.git"} }'
```

An equivalent SCP-style URI might be specified as shown in the following JSON:

```
'{"git": { "uri": "git@github.com:spring-cloud-services-samples/cook-config.git"} }'
```

The parameters used to configure SSH for a Config Server configuration source's URI are listed below.

Parameter	Function
`hostKey`	The host key of the Git server. If you have connected to the server via git on the command line, this is in your `.ssh/known_hosts`. Do not include the algorithm prefix; this is specified in `hostKeyAlgorithm`. (Optional.)
`hostKeyAlgorithm`	The algorithm of `hostKey`: one of "ssh-dss", "ssh-rsa", "ecdsa-sha2-nistp256", "ecdsa-sha2-nistp384", and "ecdsa-sha2-nistp521". (Required if supplying `hostKey`.)
`privateKey`	The private key that identifies the Git user, with all newline characters replaced by `\n`. Passphrase-encrypted private keys are not supported.

To update a Config Server service instance to use SSH to access a configuration source, allowing for host key verification, run:

```
$ cf update-service config-server -c '{"git": { "uri": "ssh://git@github.com/spring-cloud-services-samples/cook.git", "hostKey": "AAAAB3NzaC1yc2EAAAABIwAAAQEAq2A7hRGmdnm9tU
```

To update a Config Server service instance to use SSH to access a configuration source, without host key verification, run:

```
$ cf update-service config-server -c '{"git": { "uri": "ssh://git@github.com/spring-cloud-services-samples/cook.git", "privateKey": "-----BEGIN RSA PRIVATE KEY-----\nMIIJKQIB..."} }'
```

Multiple Repositories

You can configure a Config Server service instance to use multiple configuration sources, which will be used only for specific applications or for applications which are using specific profiles. To do so, you must provide parameters in repository objects within the `git.repos` JSON object. Most parameters set in the `git` object for the default configuration source are also available for specific configuration sources and can be set in repository objects within the `git.repos` object.

Each repository object in the `git.repos` object has a name. In the repository specified in the following JSON, the name is “cookie”:

```
'{ "git": { "repos": { "cookie": { "uri": "https://github.com/spring-cloud-services-samples/cook-config" } } } }'
```

Each repository object also has a `pattern`, which is a comma-separated list of application and profile names separated with forward slashes (`/`, as in `app/profile`) and potentially including wildcards (`*`, as in `app*/profile*`). If you do not supply a pattern, the repository object’s name will be used as the pattern. In the repository specified in the following JSON, the pattern is `co*/dev*` (matching any application whose name begins with `co` and which is using a profile whose name begins with `dev`), and the default pattern would be `cookie`:

```
'{"git": { "repos": { "cookie": { "pattern": "co*/dev*", "uri": "https://github.com/spring-cloud-services-samples/cook-config" } } } }'
```

For more information about the pattern format, see “Pattern Matching and Multiple Repositories” in the Spring Cloud Config documentation.

The parameters used to configure specific configuration sources for the Config Server are listed below.

Parameter	Function
`repos."name"`	A repository object, containing repository fields
`repos."name".pattern`	A pattern for the names of applications that store configuration from this repository (if not supplied, will be `"name"`)
`repos."name".uri`	The URI (`http://`, `https://`, or `ssh://`) of this repository
`repos."name".label`	The default “label” to use with this repository if a request is received without a label (e.g., if the `spring.cloud.config.label` property is not set in a client application)
`repos."name".searchPaths`	A pattern used to search for configuration-containing subdirectories in this repository
`repos."name".cloneOnStart`	Whether the Config Server should clone this repository when it starts up (by default, the Config Server will only clone the repository when configuration is first requested from the repository). Valid values are `true` and `false`
`repos."name".username`	The username used to access this repository (if protected by HTTP Basic authentication)
`repos."name".password`	The password used to access this repository (if protected by HTTP Basic authentication)
`repos."name".hostKey`	The host key used by the Config Server to access this repository (if accessing via SSH). See the SSH Repository Access section for more information
`repos."name".hostKeyAlgorithm`	The algorithm of `hostKey`: one of “ssh-dss”, “ssh-rsa”, “ecdsa-sha2-nistp256”, “ecdsa-sha2-nistp384”, and “ecdsa-sha2-nistp521”
`repos."name".privateKey`	The private key corresponding to `hostKey`, with all newline characters replaced by `\n`

Important: If you set `cloneOnStart` to `true` for a repository which is secured with HTTP Basic authentication, you must set the `username` and `password` at the same time as you set `cloneOnStart`. Otherwise, the Config Server will be unable to access the repository and the service instance may fail to initialize.

The `uri` setting is required; you cannot define a Config Server configuration source without including a `uri`.

The default value of the `label` setting is `master`. You can set `label` to a branch name, a tag name, or a specific Git commit hash.

To set `label` to point to the `develop` branch of a repository, you might configure the setting as shown in the following JSON:

```
'{"git": { "repos": { "cookie": { "uri": "https://github.com/myorg/config-repo", "label": "develop" } } } }'
```

To set `label` to point to the `v1.1` tag in a repository, you might configure the setting as shown in the following JSON:

```
'{"git": { "repos": { "cookie": { "uri": "https://github.com/myorg/config-repo", "label": "v1.1" } } } }'
```

Within a client application, you can override this `label` setting’s value by setting the `spring.cloud.config.label` property (for example, in `bootstrap.yml`).

```
spring:
  cloud:
    config:
      label: v1.2
```

To update a Config Server service instance to have a default repository and a repository specific to an application named “cook”, run:

```
$ cf update-service config-server -c '{"git": { "uri": "https://github.com/spring-cloud-services-samples/fortune-teller", "searchPaths": "configuration", "repos": { "cookie": { "pattern": "cook", "ur
```

To update a Config Server service instance to have a default repository and a repository specific to applications using the `dev` profile, run:

```
$ cf update-service config-server -c '{"git": { "uri": "https://github.com/spring-cloud-services-samples/fortune-teller", "searchPaths": "configuration", "repos": { "cookie": { "pattern": "*/dev", "u
```

Placeholders in Repository URIs

The URIs for configuration source Git repositories can include a couple of special strings as placeholders:

- `{application}` : the name set in the `spring.application.name` property on an application
- `{profile}` : a profile listed in the `spring.profiles.active` property on an application

You can use these placeholders to (for example) set a single URI which maps one repository each to multiple applications that use the same Config Server, or to set a single URI which maps one repository each to multiple profiles.

Note: URI placeholders cannot be used with a repository that has the `cloneOnStart` setting set to `true` . See the listing for `cloneOnStart` in the table of general configuration parameters.

A repository URI that enables use of one repository per application might be expressed as shown in the following JSON. For an application named “cook”, this would locate the repository named `cook-config` :

```
'{"git": { "uri": "https://github.com/spring-cloud-services-samples/{application}-config" } }'
```

A repository URI that enables use of one repository per profile might be expressed as shown in the following JSON. For an application using the `dev` profile, this would locate a repository named `config-dev` :

```
'{"git": { "uri": "https://github.com/spring-cloud-services-samples/config-{profile}" } }'
```

For more information about using placeholders, see “Placeholders in Git URI” in the Spring Cloud Config documentation.

To update a Config Server service instance to have a repository URI that enables one repository per application, run:

```
$ cf update-service config-server -c '{"git": { "uri": "https://github.com/spring-cloud-services-samples/{application}-config" } }'
```

To update a Config Server service instance to have a repository URI that enables one repository per profile, run:

```
$ cf update-service config-server -c '{"git": { "uri": "https://github.com/spring-cloud-services-samples/config-{profile}" } }'
```

HTTP(S) Proxy Repository Access

You can configure a Config Server service instance to access configuration sources using an HTTP or HTTPS proxy. To do so, you must provide proxy settings in either of the `git.proxy.http` or `git.proxy.https` JSON objects. You can set the proxy host and port, the proxy username and password (if applicable), and a list of hosts which the Config Server should access outside of the proxy.

Important: Config Server for Pivotal Cloud Foundry does not support use of a private Git repository accessed via an authenticated proxy server as a configuration source at this time.

Settings for an HTTP proxy are set in the `git.proxy.http` object. These might be set as shown in the following JSON:

```
'{"git": { "proxy": { "http": { "host": "proxy.wise.com", "port": "80" } } } }'
```

Settings for an HTTPS proxy are set in the `git.proxy.https` object. These might be set as shown in the following JSON:

```
'{"git": { "proxy": { "https": { "host": "secure.wise.com", "port": "443" } } } }'
```

The parameters used to configure HTTP or HTTPS proxy settings for the Config Server are listed below.

Parameter	Function
`proxy.http`	A proxy object, containing HTTP proxy fields
`proxy.http.host`	The HTTP proxy host
`proxy.http.port`	The HTTP proxy port
`proxy.http.nonProxyHosts`	The hosts to access outside the HTTP proxy
`proxy.http.username`	The username to use with an authenticated HTTP proxy
`proxy.http.password`	The password to use with an authenticated HTTP proxy
`proxy.https`	A proxy object, containing HTTPS proxy fields
`proxy.https.host`	The HTTPS proxy host
`proxy.https.port`	The HTTPS proxy port
`proxy.https.nonProxyHosts`	The hosts to access outside the HTTPS proxy (if `proxy.http.nonProxyHosts` is also provided, `http.nonProxyHosts` will be used instead of `https.nonProxyHosts`)
`proxy.https.username`	The username to use with an authenticated HTTPS proxy (if `proxy.http.username` is also provided, `http.username` will be used instead of `https.username`)
`proxy.https.password`	The password to use with an authenticated HTTPS proxy (if `proxy.http.password` is also provided, `http.password` will be used instead of `https.password`)

To update a Config Server service instance to use an HTTP proxy to access configuration sources, run:

```
$ cf update-service config-server -c '{"git": {"uri": "https://github.com/spring-cloud-services-samples/cook-config", "proxy": { "http": { "host": "proxy.wise.com", "port": "80" } } } }'
```

To update a Config Server service instance to use an authenticated HTTPS proxy to access configuration sources, specifying that `example.com` should be accessed outside of the proxy, run:

```
$ cf update-service config-server -c '{"git": {"uri": "https://github.com/spring-cloud-services-samples/cook-config", "proxy": { "https": { "host": "secure.wise.com", "port": "443", "username": "j
```

The Config Server

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The Config Server serves configurations stored as either Java Properties files or YAML files. It reads files from a Git repository (a *configuration source*). Given the URI of a configuration source, the server will clone the repository and make its configurations available to client applications in JSON as a series of `propertySources`.

Configuration Sources

A configuration source contains one or more configuration files used by one or more applications. Each file applies to an *application* and can optionally apply to a specific *profile* and / or *label*.

The following is the structure of a Git repository which could be used as a configuration source.

```
master
------
https://github.com/myorg/configurations
|- myapp.yml
|- myapp-development.yml
|- myapp-production.yml

tag v1.0.0
----------
https://github.com/myorg/configurations
|- myapp.yml
|- myapp-development.yml
|- myapp-production.yml
```

In this example, the configuration source defines configurations for the `myapp` application. The Server will serve different properties for `myapp` depending on the values of `{profile}` and `{label}` in the request path. If the `{profile}` is neither `development` nor `production`, the server will return the properties in `myapp.yml`, or if the `{profile}` is `production`, the server will return the properties in both `myapp-production.yml` and `myapp.yml`.

`{label}` can be a Git commit hash as well as a tag or branch name. If the request contains a `{label}` of (e.g.) `v1.0.0`, the Server will serve properties from the `v1.0.0` tag. If the request does not contain a `{label}`, the Server will serve properties from the default label. For Git repositories, the default label is **master**. You can reconfigure the default label (see the Creating an Instance topic).

Request Paths

Configuration requests use one of the following path formats:

```
/{application}/{profile}[/{label}]
/{application}-{profile}.yml
/{label}/{application}-{profile}.yml
/{application}-{profile}.properties
/{label}/{application}-{profile}.properties
```

A path includes an *application*, a *profile*, and optionally a *label*.

- **Application**: The name of the application. In a Spring application, this will be derived from `spring.application.name` or `spring.cloud.config.name`.
- **Profile**: The name of a profile, or a comma-separated list of profile names. The Config Server's concept of a "profile" corresponds directly to that of the Spring Profile.
- **Label**: The name of a version marker in the configuration source (the repository). This might be a branch name, a tag name, or a Git commit hash. The value given to the Config Server as a default label (the setting of `git.label`; see the table of the Config Server's general configuration parameters) can be overridden in a client application by setting the `spring.cloud.config.label` property.

For information about using a Cloud Foundry application as a Config Server client, see the Configuration Clients topic.

Writing Client Applications

Page last updated:

Refer to the "Cook" sample application to follow along with the code in this topic.

To use a Spring Boot application as a client for a Config Server instance, you must add the dependencies listed in the Client Dependencies topic to your application's build file. Be sure to include the dependencies for Config Server as well.

Important: Because of a dependency on Spring Security, the Spring Cloud® Config Client starter will by default cause all application endpoints to be protected by HTTP Basic authentication. If you wish to disable this, please see Disable HTTP Basic Authentication below.

Add Self-Signed SSL Certificate to JVM Truststore

Spring Cloud Services uses HTTPS for all client-to-service communication. If your Pivotal Cloud Foundry installation is using a self-signed SSL certificate, the certificate will need to be added to the JVM truststore before your client application can consume properties from a Config Server service instance.

Spring Cloud Services can add the certificate for you automatically. For this to work, you must set the `CF_TARGET` environment variable on your client application to the API endpoint of your Elastic Runtime instance:

```
$ cf set-env cook CF_TARGET https://api.cf.wise.com
Setting env variable 'CF_TARGET' to 'https://api.cf.wise.com' for app cook in org myorg / space development as user...
OK
TIP: Use 'cf restage' to ensure your env variable changes take effect

$ cf restage cook
```

As the output from the `cf set-env` command suggests, restage the application after setting the environment variable.

Use Configuration Values

When the application requests a configuration from the Config Server, it will use a path containing the application name (as described in the Configuration Clients topic). You can declare the application name in `bootstrap.properties`, `bootstrap.yml`, `application.properties`, or `application.yml`.

In `bootstrap.yml`:

```
spring:
  application:
    name: cook
```

This application will use a path with the application name `cook`, so the Config Server will look in its configuration source for files whose names begin with `cook`, and return configuration properties from those files.

Now you can (for example) inject a configuration property value using the `@Value` annotation. The Menu class reads the value of `special` from the `cook.special` configuration property.

```
@RefreshScope
@Component
public class Menu {

  @Value("${cook.special}")
  String special;

  //...

  public String getSpecial() {
    return special;
  }

  //...

}
```

The `Application` class is a `@RestController`. It has an injected `menu` and returns the `special` (the value of which will be supplied by the Config Server) in its `restaurant()` method, which it maps to `/restaurant`.

```
@RestController
@SpringBootApplication
public class Application {

  @Autowired
  private Menu menu;

  @RequestMapping("/restaurant")
  public String restaurant() {
    return String.format("Today's special is: %s", menu.getSpecial());
  }
  //...
```

Vary Configurations Based on Profiles

You can provide configurations for multiple profiles by including appropriately-named `.yml` or `.properties` files in the Config Server instance's configuration source (the Git repository). Filenames follow the format `{application}-{profile}.{extension}`, as in `cook-production.yml`. (See the The Config Server topic.)

The application will request configurations for any active profiles. To set profiles as active, you can use the `SPRING_PROFILES_ACTIVE` environment variable, set for example in `manifest.yml`.

```
applications:
  - name: cook
    host: cookie
    services:
      - config-server
    env:
      SPRING_PROFILES_ACTIVE: production
```

The sample configuration source cook-config contains the files `cook.properties` and `cook-production.properties`. With the active profile set to `production` as in `manifest.yml` above, the application will make a request of the Config Server using the path `/cook/production`, and the Config Server will return properties from both `cook-production.properties` (the profile-specific configuration) and `cook.properties` (the default configuration); for example:

```
{
  "name":"cook",
  "profiles":[
    "production"
  ],
  "label":"master",
  "propertySources":[
    {
      "name":"https://github.com/spring-cloud-services-samples/cook-config/cook-production.properties",
      "source":
        {
          "cook.special":"Cake a la mode"
        }
    },
    {
      "name":"https://github.com/spring-cloud-services-samples/cook-config/cook.properties",
      "source":
        {
          "cook.special":"Pickled Cactus"
        }
    }
  ]
}
```

As noted in the Configuration Clients topic, the application must decide what to do when the server returns multiple values for a configuration property, but a Spring application will take the first value for each property. In the example response above, the configuration for the specified profile (`production`) is first in the list, so the Boot sample application will use values from that configuration.

View Client Application Configuration

Spring Boot Actuator adds an `env` endpoint to the application and maps it to `/env`. This endpoint displays the application's profiles and property sources from the Spring `ConfigurableEnvironment`. (See "Endpoints" in the "Spring Boot Actuator" section of the Spring Boot Reference Guide.) In the case of an application which is bound to a Config Server service instance, `env` will display properties provided by the instance.

To use Actuator, you must add the `spring-boot-starter-actuator` dependency to your project. If using Maven, add to `pom.xml`:

```
<dependency>
  <groupId>org.springframework.boot</groupId>
  <artifactId>spring-boot-starter-actuator</artifactId>
</dependency>
```

If using Gradle, add to `build.gradle`:

```
compile("org.springframework.boot:spring-boot-starter-actuator")
```

You can now visit `/env` to see the application environment's properties (the following shows an excerpt of an example response):

```
$ curl http://cookie.apps.wise.com/env
{
  "profiles":[
    "dev","cloud"
  ],
  "configService:https://github.com/spring-cloud-services-samples/cook-config/cook.properties":{
    "cook.special":"Pickled Cactus"
  },
  "vcap":{
    "vcap.application.limits.mem":"512",
    "vcap.application.application_uris":"cookie.apps.wise.com",
    "vcap.services.config-server.name":"config-server",
    "vcap.application.uris":"cookie.apps.wise.com",
    "vcap.application.application_version":"179de3f9-38b6-4939-bff5-41a14ce4e700",
    "vcap.services.config-server.tags[0]":"configuration",
    "vcap.application.space_name":"development",
    "vcap.services.config-server.plan":"standard",
//...
```

Refresh Client Application Configuration

Spring Boot Actuator also adds a `refresh` endpoint to the application. This endpoint is mapped to `/refresh`, and a POST request to the `refresh` endpoint

refreshes any beans which are annotated with `@RefreshScope`. You can thus use `@RefreshScope` to refresh properties which were initialized with values provided by the Config Server.

The `Menu.java` class is marked as a `@Component` and also annotated with `@RefreshScope`.

```
import org.springframework.cloud.context.config.annotation.RefreshScope;
import org.springframework.stereotype.Component;

@RefreshScope
@Component
public class Menu {

  @Value("${cook.special}")
  String special;
  //...
```

This means that after you change values in the configuration source repository, you can update the `special` on the `Application` class's `menu` with a refresh event triggered on the application:

```
$ curl http://cookie.apps.wise.com/restaurant
Today's special is: Pickled Cactus

$ git commit -am "new special"
[master 3c9ff23] new special
 1 file changed, 1 insertion(+), 1 deletion(-)

$ git push

$ curl -X POST http://cookie.apps.wise.com/refresh
["cook.special"]

$ curl http://cookie.apps.wise.com/restaurant
Today's special is: Birdfeather Tea
```

Use Client-Side Decryption

On the Config Server, the decryption features are disabled, so encrypted property values from a configuration source are delivered to client applications unmodified. You can use the decryption features of Spring Cloud Config Client to perform client-side decryption of encrypted values.

To use the decryption features in a client application, you must use a Java buildpack which contains the Java Cryptography Extension (JCE) Unlimited Strength policy files. These files are contained in the Cloud Foundry Java buildpack from version 3.7.1.

> If you cannot use version 3.7.1 or later, you can add the JCE Unlimited Strength policy files to an earlier version of the Cloud Foundry Java buildpack. Fork the buildpack on GitHub, then download the policy files from Oracle and place them in the buildpack's `resources/open_jdk_jre/lib/security` directory. Follow the instructions in the Adding Buildpacks to Cloud Foundry topic to add this buildpack to Pivotal Cloud Foundry. Be sure that it has the lowest position of all enabled Java buildpacks.

You must also include Spring Security RSA as a dependency and specify version 1.0.5.RELEASE of Spring Cloud Context in your client application's build file.

If using Maven, include in `pom.xml`:

```
<dependency>
  <groupId>org.springframework.security</groupId>
  <artifactId>spring-security-rsa</artifactId>
</dependency>

<dependency>
  <groupId>org.springframework.cloud</groupId>
  <artifactId>spring-cloud-context</artifactId>
  <version>1.0.5.RELEASE</version>
</dependency>
```

If using Gradle, include in `build.gradle`:

```
compile("org.springframework.security:spring-security-rsa")
compile("org.springframework.cloud:spring-cloud-context:1.0.5.RELEASE")
```

Encrypted values must be prefixed with the string `{cipher}`. If using YAML, enclose the entire value in single quotes, as in `'{cipher}vALuE'`; if using a properties file, do not use quotes. The configuration source for the Cook application has a `secretMenu` property in its `cook-encryption.properties`:

```
secretMenu={cipher}AQA90Q3GIRAMu6ToMqwS++En2iFzMXIWX99G66yaZFRHrQNq64CntqOzWymd3xE7uJpZK
Qc9XBIkfyRz/HUGhXRdf3KZQ9bqclwmR5vkiLmN9DHIAxS+6biT+7f8ptKo3fzQ0gGOBaR4kTnWLBxmVaIkjq1Qz
e4aIgsgUWuhbEek+3znkH9+Mc+5zNPvwN8hhgDMDVzgZLB+4YnvWJAq3Au4wEevakAHHxVY0mXcxj1Ro+H+ZelIz
fF8K2AvC3vmvlmxy9Y49Zjx0RhMzUx17eh3mAB8UMMRJZyUG2a2uGCXmz+UunTA5n/dWWOvR3VcZyzXPFSFkhNek
w3db9XZ7goceJSPrRN+5s+GjLCPr+KSnhLmUt1XAScMeqTieNCHT5I=
```

Put the key on the client application classpath. You can either add the keystore to the buildpack's `resources/open_jdk_jre/lib/security` directory (as described above for the JCE policy files) or include it with the source for the application. In the Cook application, the key is placed in `src/main/resources`.

```
cook
└── src
    └── main
        └── resources
            ├── application.yml
            ├── bootstrap.yml
            └── server.jks
```

Important: Cook is an example application, and the key is packaged with the application source for example purposes. If at all possible, use the buildpack for keystore distribution.

Specify the key location and credentials in `bootstrap.properties` or `bootstrap.yml` using the `encrypt.keyStore` properties:

```
encrypt:
  keyStore:
    location: classpath:/server.jks
    password: letmein
    alias: mytestkey
    secret: changeme
```

The Menu class has a String property `secretMenu`.

```
@Value("${secretMenu}")
String secretMenu;

//...

public String getSecretMenu() {
  return secretMenu;
}
```

A default value for `secretMenu` is in `bootstrap.yml`:

```
secretMenu: Animal Crackers
```

In the Application class, the method `secretMenu()` is mapped to `/restaurant/secret-menu`. It returns the value of the `secretMenu` property.

```
@RequestMapping("/restaurant/secret-menu")
public String secretMenu() {
  return menu.getSecretMenu();
}
```

After making the key available to the application and installing the JCE policy files in the Java buildpack, you can cause the Config Server to serve properties from the `cook-encryption.properties` file by activating the `encryption` profile on the application, e.g. by running `cf set-env` to set the `SPRING_PROFILES_ACTIVE` environment variable:

```
$ cf set-env cook SPRING_PROFILES_ACTIVE dev,encryption
Setting env variable 'SPRING_PROFILES_ACTIVE' to 'dev,encryption' for app cook in org myorg / space development as user...
OK
TIP: Use 'cf restage' to ensure your env variable changes take effect

$ cf restage cook
```

The application will decrypt the encrypted property after receiving it from the Config Server. You can view the property value by visiting `/restaurant/secret-menu` on the application.

Disable HTTP Basic Authentication

The Spring Cloud Config Client starter has a dependency on Spring Security. Unless your application has other security configuration, this will cause all application endpoints to be protected by HTTP Basic authentication.

If you do not yet want to address application security, you can turn off Basic authentication by setting the `security.basic.enabled` property to `false`. In `application.yml` or `bootstrap.yml`:

```
security:
  basic:
    enabled: false
```

You might make this setting specific to a profile (such as the `dev` profile if you want Basic authentication disabled only for development):

```
---
spring:
  profiles: dev

security:
  basic:
    enabled: false
```

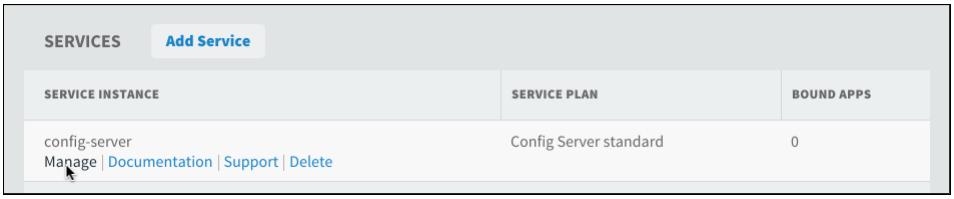
For more information, see "Security" in the Spring Boot Reference Guide.

Note: Because of the Spring Security dependency, HTTPS Basic authentication will also be enabled for Spring Boot Actuator endpoints. If you wish to disable that as well, you must also set the `management.security.enabled` property to `false`. See "Customizing the management server port" in the Spring Boot Reference Guide.

Using the Dashboard

Page last updated:

To find the dashboard, navigate in Pivotal Cloud Foundry® Apps Manager to the Config Server service instance's space and click **Manage** in the listing for the service instance.

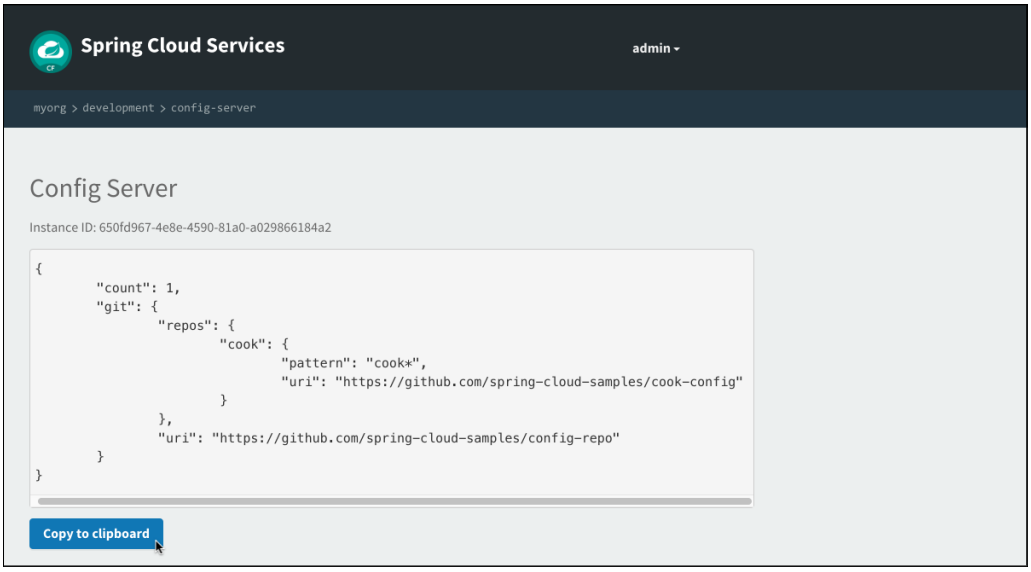


If you are using version 6.8.0 or later of the Cloud Foundry Command Line Interface tool (cf CLI), you can also use `cf service SERVICE_NAME`, where `SERVICE_NAME` is the name of the Config Server service instance:

```
$ cf service config-server

Service instance: config-server
Service: p-config-server
Bound apps:
Tags:
Plan: standard
Description: Config Server for Spring Cloud Applications
Documentation url: http://docs.pivotal.io/spring-cloud-services/
Dashboard: https://spring-cloud-broker.apps.wise.com/dashboard/p-config-server/650fd967-4e8e-4590-81a0-a029866184a2

Last Operation
Status: update succeeded
Message:
Started: 2016-06-27T14:30:23Z
Updated: 2016-06-27T14:32:30Z
```

Visit the URL given for "Dashboard".

The dashboard shows the JSON object used to configure Config Server settings. You can click the **Copy to clipboard** button to obtain this object in a string format suitable for use in command lines.



For the settings shown in the above figure, the button copies the following to the clipboard:

```
"{\"count\":1,\"git\":{\"repos\":{\"cook\":{\"pattern\":\"cook*\",\"uri\":\"https://github.com/spring-cloud-samples/cook-config\"}},\"uri\":\"https://github.com/spring-cloud-samples/config-repo\"}
```

Additional Resources

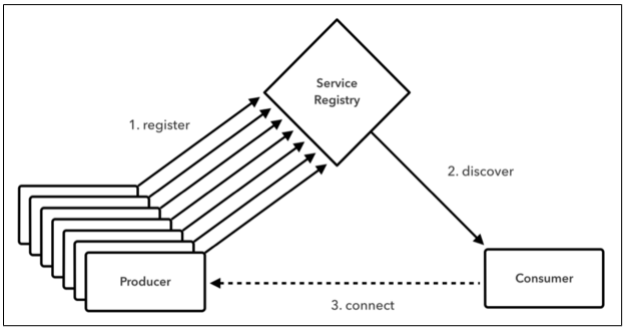
Page last updated:

- Spring Cloud® Services 1.0.0 on Pivotal Cloud Foundry - Config Server - YouTube (short screencast demonstrating Config Server for Pivotal Cloud Foundry)
- Spring Cloud Config (documentation for Spring Cloud Config, the open-source project that underlies Config Server for Pivotal Cloud Foundry)
- "Configuring It All Out" or "12-Factor App-Style Configuration with Spring" (blog post that provides background on Spring's configuration mechanisms and on Spring Cloud Config)
- Environment abstraction (Spring Framework Reference Documentation) (Spring Framework documentation on the `Environment` and the concepts of profiles and properties)

Service Registry for Pivotal Cloud Foundry

Overview

Service Registry for Pivotal Cloud Foundry (PCF) provides your applications with an implementation of the Service Discovery pattern, one of the key tenets of a microservice-based architecture. Trying to hand-configure each client of a service or adopt some form of access convention can be difficult and prove to be brittle in production. Instead, your applications can use the Service Registry to dynamically discover and call registered services.



When a client registers with the Service Registry, it provides metadata about itself, such as its host and port. The Registry expects a regular heartbeat message from each service instance. If an instance begins to consistently fail to send the heartbeat, the Service Registry will remove the instance from its registry.

Service Registry for Pivotal Cloud Foundry is based on Eureka, Netflix's Service Discovery server and client. For more information about Eureka and about the Service Discovery pattern, see Additional Resources.

Refer to the sample applications in the "greeting" repository to follow along with code in this section.

Creating an Instance

Page last updated:

You can create a Service Registry service instance using either the Cloud Foundry Command Line Interface tool (cf CLI) or Pivotal Cloud Foundry (PCF) Apps Manager.

Note: Service Registry service instances can run in a high-availability mode, with an arbitrary number of replicated nodes. This currently can only be configured through use of the cf CLI. (After creating a service instance using Apps Manager, you can use the cf CLI to set the number of nodes. See the Updating an Instance topic.)

Using the cf CLI

Target the correct org and space:

```
$ cf target -o myorg -s development

API endpoint:   https://api.cf.wise.com (API version: 2.43.0)
User:           user
Org:            myorg
Space:          development
```

You can view plan details for the Config Server product by running `cf marketplace -s`.

```
$ cf marketplace
Getting services from marketplace in org myorg / space development as user...
OK

service                     plans          description
p-circuit-breaker-dashboard   standard       Circuit Breaker Dashboard for Spring Cloud Applications
p-config-server               standard       Config Server for Spring Cloud Applications
p-service-registry            standard       Service Registry for Spring Cloud Applications

TIP:  Use 'cf marketplace -s SERVICE' to view descriptions of individual plans of a given service.

$ cf marketplace -s p-service-registry
Getting service plan information for service p-service-registry as user...
OK

service plan   description     free or paid
standard       Standard Plan   free
```

Run `cf create-service`, specifying the service, plan name, and instance name. Optionally, you may add the `-c` flag and provide a JSON object that specifies the number of nodes to provision as `count` (by default, the instance will be provisioned with only a single node).

To create an instance with a single node, run:

```
$ cf create-service p-service-registry standard service-registry
Creating service instance service-registry in org myorg / space development as admin...
OK

Create in progress. Use 'cf services' or 'cf service service-registry' to check operation status.
```

To create an instance with three nodes, run:

```
$ cf create-service p-service-registry standard service-registry -c '{"count": 3}'
Creating service instance service-registry in org myorg / space development as admin...
OK

Create in progress. Use 'cf services' or 'cf service service-registry' to check operation status.
```

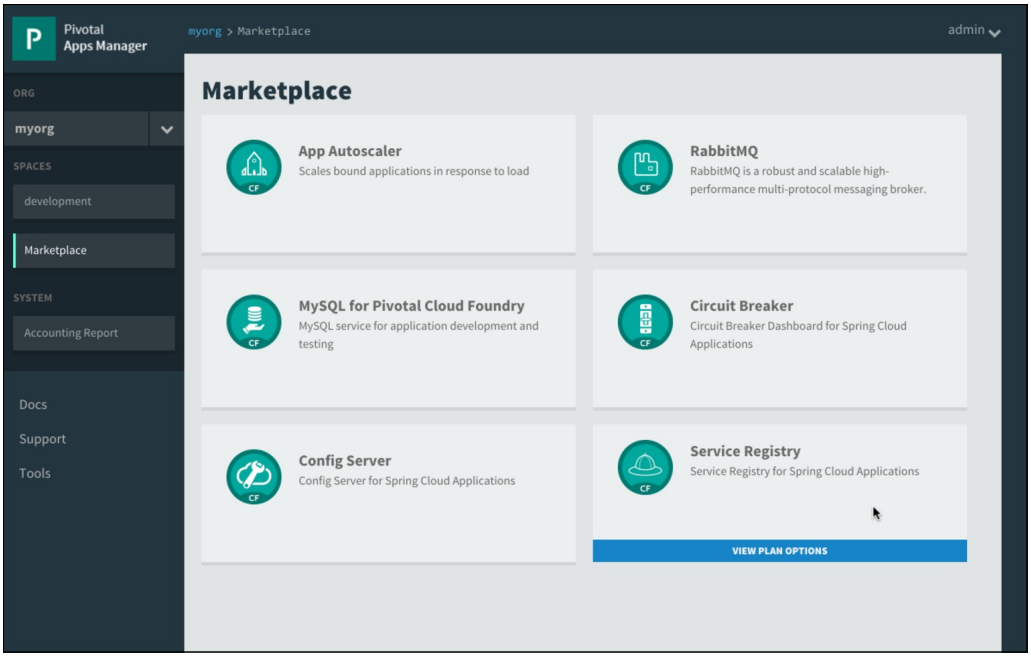
As the command output suggests, you can use the `cf services` or `cf service` commands to check the status of the service instance. When the Service Registry instance is ready to be used, the `cf service` command will give a status of `create succeeded`:

```
$ cf service service-registry

Service instance: service-registry
Service: p-service-registry
Bound apps:
Tags:
Plan: standard
Description: Service Registry for Spring Cloud Applications
Documentation url: http://docs.pivotal.io/spring-cloud-services/
Dashboard: https://spring-cloud-broker.apps.wise.com/dashboard/p-service-registry/50f247f4-fcb0-43c9-863c-94e21be2051c

Last Operation
Status: create succeeded
Message:
Started: 2016-06-27T23:14:44Z
Updated:
```

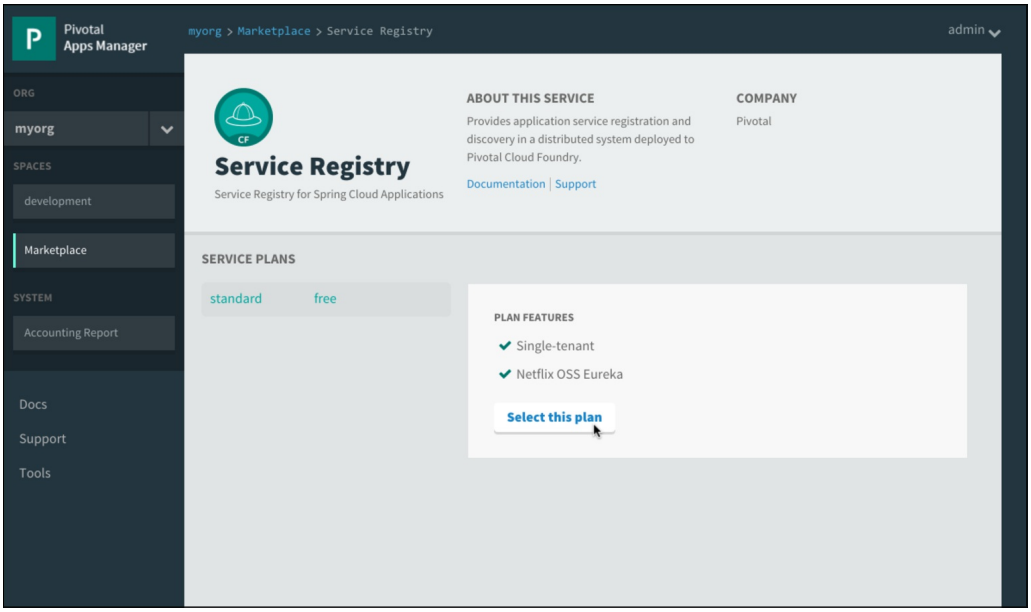
Note: You may notice a discrepancy between the status given for a service instance by the cf CLI (e.g., by the `cf service` command) versus that shown on the Service Instances dashboard. The dashboard is updated frequently (close to real-time); the status retrieved by the cf CLI is not updated as frequently and may take time to match the dashboard.

Using Apps Manager

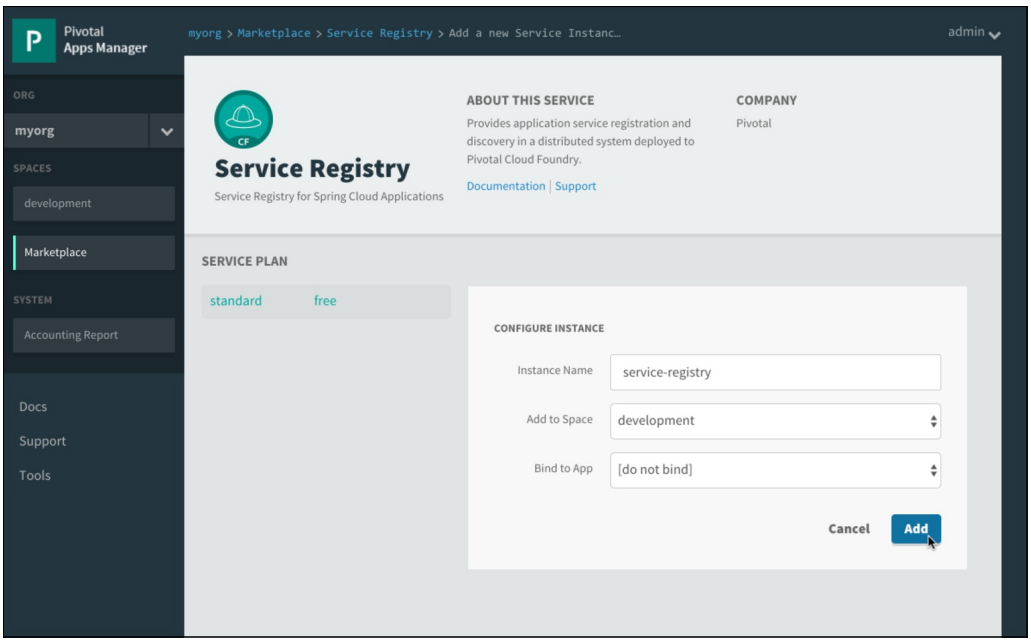
Log into Apps Manager as a Space Developer. In the Marketplace, select **Service Registry**.



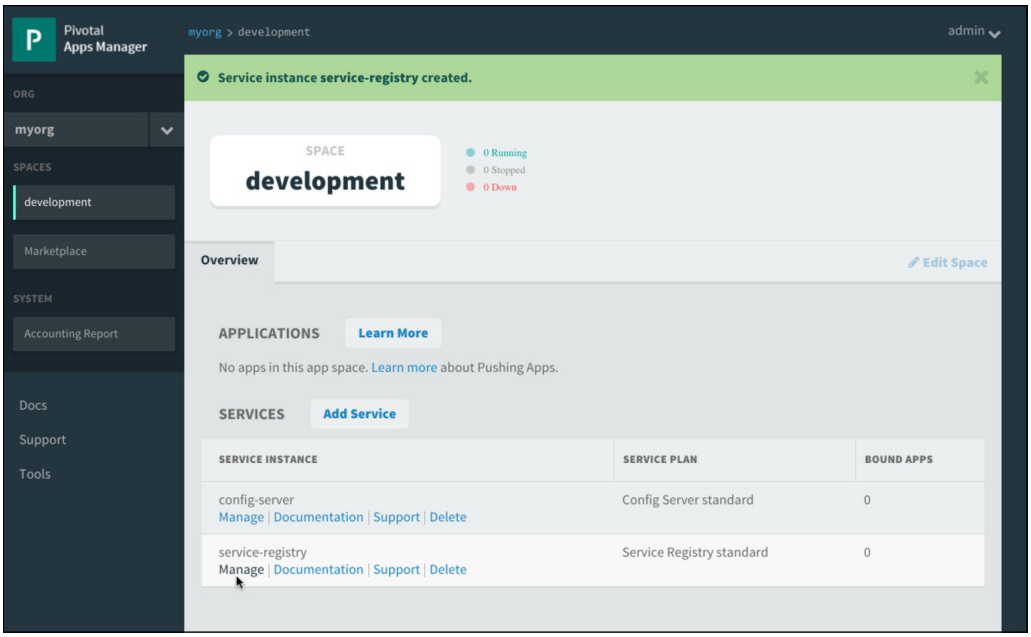
Select the desired plan for the new service instance.



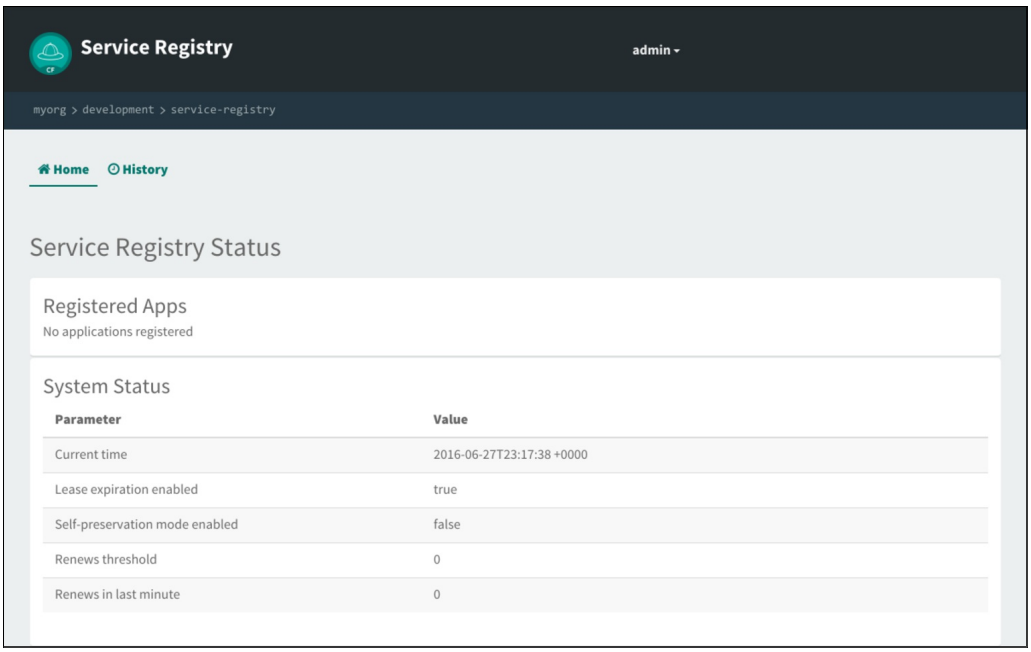
Provide a name for the service instance (for example, “service-registry”). Click the **Add** button.



In the **Services** list, click the **Manage** link under the listing for the new service instance.



It may take a few minutes to provision the service instance; while it is being provisioned, you will see a “The service instance is initializing” message. When the instance is ready, its dashboard will load automatically.



For information about registering an application with a Service Registry service instance, see the Writing Client Applications topic.

Updating an Instance

Page last updated:

You can update settings on a Service Registry service instance using the Cloud Foundry Command Line Interface tool (cf CLI). The `cf update-service` command can be given a `-c` flag with a JSON object containing parameters used to configure the service instance.

Parameters accepted for the Service Registry are listed below.

Parameter	Function	Example
`count`	The number of nodes to provision	`'{"count": 3}'`
`upgrade`	Whether to upgrade the instance	`'{"upgrade": true}'`

To update a Service Registry service instance's settings, target the org and space of the service instance:

```
$ cf target -o myorg -s development

API endpoint:   https://api.cf.wise.com (API version: 2.43.0)
User:           user
Org:            myorg
Space:          development
```

Then run `cf update-service SERVICE_NAME -c '{ "PARAMETER": "VALUE" }'`, where `SERVICE_NAME` is the name of the service instance, `PARAMETER` is a supported parameter, and `VALUE` is the value for the parameter. To update a service instance and set the count of nodes for running in high-availability mode, run:

```
$ cf update-service service-registry -c '{"count": 3}'
Updating service instance service-registry as admin...
OK

Update in progress. Use 'cf services' or 'cf service service-registry' to check operation status.
```

As the command output suggests, you can use the `cf services` or `cf service` commands to check the status of the service instance. When the update is complete, the `cf service` command will give a status of `update succeeded`:

```
$ cf service service-registry

Service instance: service-registry
Service: p-service-registry
Bound apps:
Tags:
Plan: standard
Description: Service Registry for Spring Cloud Applications
Documentation url: http://docs.pivotal.io/spring-cloud-services/
Dashboard: https://spring-cloud-broker.apps.wise.com/dashboard/p-service-registry/57ce88c1-6bd9-4224-b855-b4600e8e0f39

Last Operation
Status: update succeeded
Message:
Started: 2016-06-28T14:09:19Z
Updated: 2016-06-28T14:12:25Z
```

The service instance is now updated and ready to be used. For information about registering an application with a Service Registry service instance or calling an application which has been registered with a Service Registry service instance, see the Writing Client Applications topic.

Writing Client Applications

Page last updated:

Refer to the sample applications in the "greeting" repository to follow along with the code in this topic.

To register your application with a Service Registry service instance or use it to consume a service that is registered with a Service Registry service instance, you must add the dependencies listed in the Client Dependencies topic to your application's build file. Be sure to include the dependencies for Service Registry as well.

Important: Because of a dependency on Spring Security, the Spring Cloud Services Starters for Service Registry will by default cause all application endpoints to be protected by HTTP Basic authentication. If you wish to disable this, please see Disable HTTP Basic Authentication below.

Add Self-Signed SSL Certificate to JVM Truststore

Spring Cloud® Services uses HTTPS for all client-to-service communication. If your Pivotal Cloud Foundry (PCF) installation is using a self-signed SSL certificate, the certificate will need to be added to the JVM truststore before your application can be registered with a Service Registry service instance or consume a service that is registered with a Service Registry service instance.

Spring Cloud Services can add the certificate for you automatically. For this to work, you must set the `CF_TARGET` environment variable on your application to the API endpoint of your Elastic Runtime instance:

```
$ cf set-env message-generation CF_TARGET https://api.cf.wise.com
Setting env variable 'CF_TARGET' to 'https://api.cf.wise.com' for app message-generation in org myorg / space development as user...
OK
TIP: Use 'cf restage message-generation' to ensure your env variable changes take effect
$ cf restage message-generation
```

As the output from the `cf set-env` command suggests, restage the application after setting the environment variable.

Register a Service

Follow the below instructions to register an application with a Service Registry service instance.

Identify the Application

Your service application must include the `@EnableDiscoveryClient` annotation on a configuration class.

```
@SpringBootApplication
@EnableDiscoveryClient
@RestController
public class MessageGenerationApplication {
  //...
```

The `MessageGenerationApplication` class also has a `/greeting` endpoint which gives a JSON `Greeting` object.

```
  @RequestMapping("/greeting")
  public Greeting greeting(@RequestParam(value="salutation",
                    defaultValue="Hello") String salutation,
                   @RequestParam(value="name",
                    defaultValue="Bob") String name) {
    //...
    return new Greeting(salutation, name);
  }
```

The application's Eureka instance name (the name by which it will be registered in Eureka) will be derived from the value of the `spring.application.name` property on the application. If you do not provide a value for this property, the application's Eureka instance name will be derived from its Cloud Foundry application name, as set in `manifest.yml`:

```
---
instances: 1
memory: 1G
applications:
  - name: message-generation
  ...
```

Set the `spring.application.name` property in `application.yml`:

```
spring:
  application:
    name: message-generation
```

Note: If the application name contains characters which are invalid in a hostname, the application will be registered with the Service Registry service instance using the application name with each invalid character replaced by a hyphen (`-`) character (for example, given an application name of "message_generation", the virtual hostname used to register the application with the Service Registry service instance will be `message-generation`). See the Eureka Virtual Hostname Configuration section of the Spring Cloud Connectors topic for more information.

Register the Application

Optionally, you may also specify the registration method that you wish to use for the application, using the `spring.cloud.services.registrationMethod` property. It can take either of two values:

- `route`: The application will be registered using its Cloud Foundry route.
- `direct`: The application will be registered using its host IP and port.

The default value for the `registrationMethod` property is `route`. You may also provide configuration using properties under `eureka.instance`, such as `eureka.instance.hostname` and `eureka.instance.nonSecurePort` (see the Spring Cloud Netflix documentation); if you do, those properties will override the value of `registrationMethod`.

See below for information about the `route` and `direct` registration methods.

Route Registration

An application deployed to PCF can have one or more URLs, or "routes," bound to it. If you specify the `route` registration method, the application will be registered with the Service Registry instance using the first of these routes from the `uris` list in the application's `VCAP_APPLICATION` environment variable.

```
{
 "VCAP_APPLICATION": {

  "name": "message-generation",
  "space_id": "0fa9f93a-d1fa-43c8-b11b-f95b7e36fd32",
  "space_name": "development",
  "uris": [
   "message-generation.apps.wise.com"
  ],
```

Requests from client applications to this registered application go through the Pivotal Cloud Foundry Router, and the Router provides load balancing between the clients and registered applications.

This registration method is compatible with all deployments of PCF.

Direct Registration

> **Important**: On PCF 1.7, network communication between containers in the same cell is not allowed. This makes direct registration unreliable, since applications registering to the service registry and client applications discovering the registered applications may be deployed to the same cell. Use of the direct registration method is therefore not recommended or supported on PCF 1.7.

An application running on Pivotal Cloud Foundry is provided with an externally-accessible IP address and port, which are made available in two environment variables: `CF_INSTANCE_IP` and `CF_INSTANCE_PORT`. If you specify the `direct` registration method, the application will be registered with the Service Registry instance using this IP address and port.

Requests from client applications to this registered application will not go through the Pivotal Cloud Foundry Router. You can provide client-side load balancing using Spring Cloud and Netflix Ribbon.

To enable direct registration, you must configure the PCF environment to allow traffic across containers or cells. In PCF 1.6, visit the Pivotal Cloud Foundry® Operations Manager, click the **Pivotal Elastic Runtime** tile, and in the **Security Config** tab, ensure that the "Enable cross-container traffic" option is enabled. In PCF 1.7, application security groups must be configured to allow direct communication between applications across cells. Direct cross-cell communication is allowed by the default security groups created during Elastic Runtime installation.

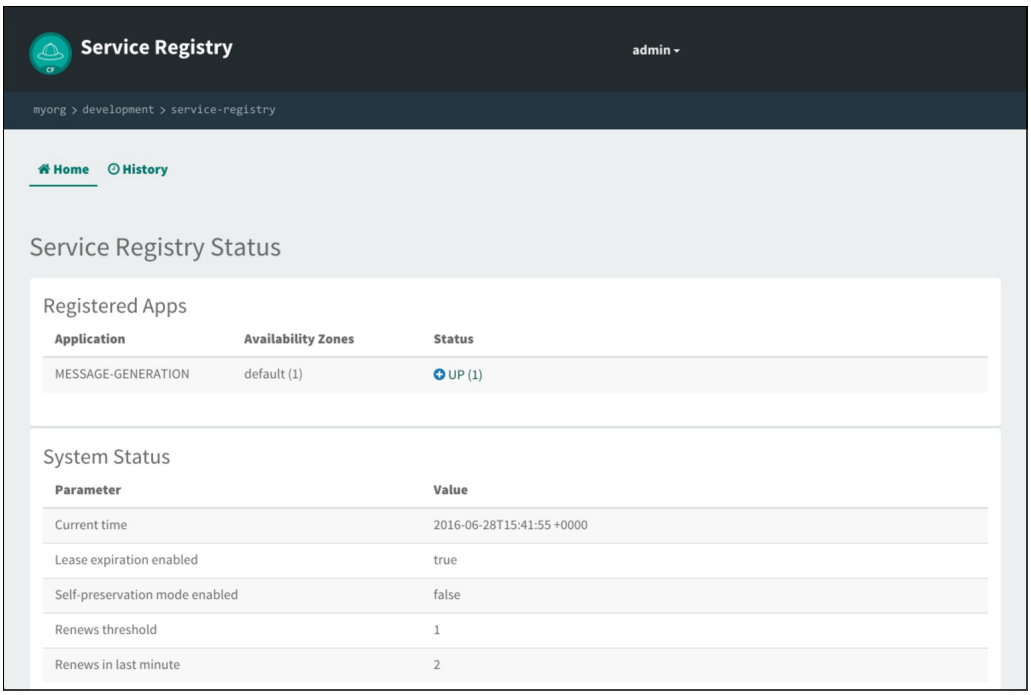
Specify a Registration Method

If you do wish to specify a registration method, set the `spring.cloud.services.registrationMethod` property. In `application.yml`:

```
spring:
  application:
    name: message-generation
  cloud:
    services:
      registrationMethod: route
```

As mentioned above, the `route` method is the default; it will be used if you do not specify `registrationMethod`.

With the `spring.application.name` property set, you can now bind the application to a Service Registry instance. Once it has been bound and restaged and has successfully registered with the Registry, you will see it listed in the Service Registry dashboard (see the Using the Dashboard topic).



Consume a Service

Follow the below instructions to consume a service that is registered with a Service Registry service instance.

Discover and Consume a Service Using RestTemplate

A consuming application must include the `@EnableDiscoveryClient` annotation on a configuration class.

```
@SpringBootApplication
@EnableDiscoveryClient
@RestController
public class GreeterApplication {

  @Bean
  @LoadBalanced
  public RestTemplate restTemplate() {
    return new RestTemplate();
  }

  @Autowired
  private RestTemplate rest;
  //...
```

To call a registered service, a consuming application can use a URI with a hostname matching the name with which the service is registered in the Service Registry. This way, the consuming application does not need to know the service application's actual URL; the Registry will take care of finding and routing to the service.

Note: If the name of the registered application contains characters which are invalid in a hostname, that application will be registered with the Service Registry service instance using the application name with each invalid character replaced by a hyphen (`-`) character. For example, given an application name of "message_generation", the virtual hostname used to register the application with the Service Registry service instance will be `message-generation`. See the Eureka Virtual Hostname Configuration section of the Spring Cloud Connectors topic for more information.

Important: If your PCF installation is configured to only allow HTTPS traffic, you must specify the `https://` scheme in the base URI used by your client application. For the below example, this means that you must change the base URI from `http://message-generation/greeting` to `https://message-generation/greeting`.

By default, Service Registry requires HTTPS for access to registered services. If your client application is consuming a service application which has been registered with the Service Registry instance using route registration (see the Register the Application section above), you have two options:

1. Use the `https://` URI scheme to access the service.
2. In your application configuration, set the `ribbon.IsSecure` property to `false`, and use the `http://` URI scheme to access the service.

If you wish to use HTTP rather than HTTPS, set `ribbon.IsSecure` first. In `application.yml`:

```
ribbon:
  IsSecure: false
```

The Message Generation application is registered with the Service Registry instance as `message-generation`, so in the Greeter application, the `hello()` method on the `GreeterApplication` class uses the base URI `http://message-generation` to get a greeting message from Message Generation.

```
@RequestMapping(value = "/hello", method = RequestMethod.GET)
public String hello(@RequestParam(value="salutation",
                                  defaultValue="Hello") String salutation,
                    @RequestParam(value="name",
                                  defaultValue="Bob") String name) {
    URI uri = UriComponentsBuilder.fromUriString("http://message-generation/greeting")
        .queryParam("salutation", salutation)
        .queryParam("name", name)
        .build()
        .toUri();

    Greeting greeting = rest.getForObject(uri, Greeting.class);
    return greeting.getMessage();
}
```

Greeter's `Greeting` class uses Jackson's `@JsonCreator` and `@JsonProperty` to read in the JSON response from Message Generation.

```
private static class Greeting {

    private String message;

    @JsonCreator
    public Greeting(@JsonProperty("message") String message) {
        this.message = message;
    }

    public String getMessage() {
        return this.message;
    }

}
```

The Greeter application now responds with a customizable `Greeting` when you access its `/hello` endpoint.

```
$ curl http://greeter.apps.wise.com/hello
Hello, Bob!

$ curl http://greeter.apps.wise.com/hello?name=John
Hello, John!
```

Discover and Consume a Service Using Feign

If you wish to use Feign to consume a service that is registered with a Service Registry instance, your application must declare `spring-cloud-starter-feign` as a dependency. In order to have Feign client interfaces automatically configured, it must also use the `@EnableFeignClients` annotation.

Your consuming application must include the `@EnableDiscoveryClient` annotation on a configuration class. In the Greeter application, the `GreeterApplication` class contains a `MessageGenerationClient` interface, which is a Feign client for the Message Generation application.

```
@SpringBootApplication
@EnableDiscoveryClient
@EnableFeignClients
@RestController
public class GreeterApplication {

    @Autowired
    MessageGenerationClient messageGeneration;
    //...
```

To call a registered service, a consuming application can use a URI with a hostname matching the name with which the service is registered in the Service Registry. This way, the consuming application does not need to know the service application's actual URL; the Registry will take care of finding and routing to the service.

Note: If the name of the registered application contains characters which are invalid in a hostname, that application will be registered with the Service Registry service instance using the application name with each invalid character replaced by a hyphen (`-`) character. For example, given an application name of "message_generation", the virtual hostname used to register the application with the Service Registry service instance will be `message-generation`. See the Eureka Virtual Hostname Configuration section of the Spring Cloud Connectors topic for more information.

Important: If your PCF installation is configured to only allow HTTPS traffic, you must specify the `https://` scheme in the base URI used by your client application. For the below example, this means that you must change the base URI from `http://message-generation/greeting` to `https://message-generation/greeting`.

By default, Service Registry requires HTTPS for access to registered services. If your client application is consuming a service application which has been registered with the Service Registry instance using route registration (see the Register the Application section above), you have two options:

1. Use the `https://` URI scheme to access the service.
2. In your application configuration, set the `ribbon.IsSecure` property to `false`, and use the `http://` URI scheme to access the service.

If you wish to use HTTP rather than HTTPS, set `ribbon.IsSecure` first. In `application.yml`:

```
ribbon:
  IsSecure: false
```

The Message Generation application is registered with the Service Registry instance as `message-generation`, so the `@FeignClient` annotation on the `MessageGenerationClient` interface uses the base URI `http://message-generation`. The interface declares one method, `greeting()`, which accesses the Message Generation application's `/greeting` endpoint and sends along optional `name` and `salutation` parameters if they are provided.

```
@FeignClient("http://message-generation")
interface MessageGenerationClient {
  @RequestMapping(value = "/greeting", method = GET)
  Greeting greeting(@RequestParam("name") String name, @RequestParam("salutation") String salutation);
}
```

Greeter's `Greeting` class uses Jackson's `@JsonCreator` and `@JsonProperty` to read in the JSON response from Message Generation.

```
private static class Greeting {

    private String message;

    @JsonCreator
    public Greeting(@JsonProperty("message") String message) {
        this.message = message;
    }

    public String getMessage() {
        return this.message;
    }

}
```

Its `greeting()` method is mapped to the `/hello` endpoint and calls the `greeting()` method on `MessageGenerationClient` to get a greeting.

```
@RequestMapping(value = "/hello", method = GET)
public String greeting(@RequestParam(value="salutation", defaultValue="Hello") String salutation, @RequestParam(value="name", defaultValue="Bob") String name) {
  Greeting greeting =  messageGeneration.greeting(name, salutation);
  return greeting.getMessage();
}
```

The Greeter application now responds with a customizable `Greeting` when you access its `/hello` endpoint.

```
$ curl http://greeter.apps.wise.com/hello
Hello, Bob!

$ curl http://greeter.apps.wise.com/hello?name=John
Hello, John!
```

Disable HTTP Basic Authentication

The Spring Cloud Services Starter for Service Registry has a dependency on Spring Security. Unless your application has other security configuration, this will cause all application endpoints to be protected by HTTP Basic authentication.

If you do not yet want to address application security, you may turn off Basic authentication by setting the `security.basic.enabled` property to `false`. In `application.yml` or `bootstrap.yml`:

```
security:
  basic:
    enabled: false
```

You might make this setting specific to a profile (such as the `dev` profile if you want Basic authentication disabled only for development):

```
---

spring:
  profiles: dev

security:
  basic:
    enabled: false
```

For more information, see "Security" in the Spring Boot Reference Guide.

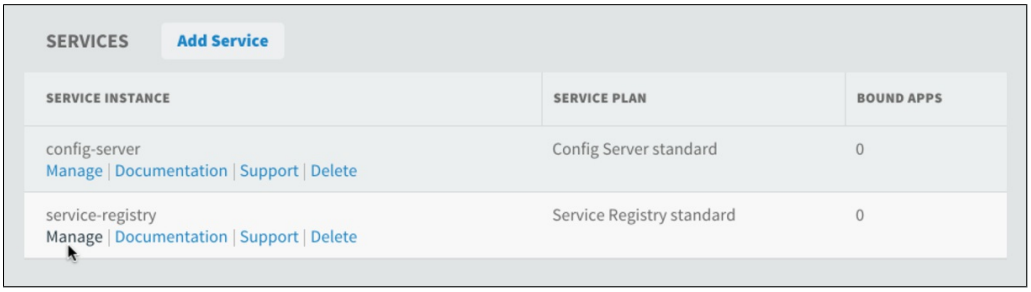
Using the Dashboard

Page last updated:

Note: Service Registry for Pivotal Cloud Foundry is currently based on Spring Cloud® OSS Brixton. If binding a Spring Cloud OSS Angel application to a Service Registry service instance, you may see irregular behavior in the Service Registry service instance dashboard's listing for the application.

For information on current client dependencies provided for use with Spring Cloud Services service instances, see the Client Dependencies topic.

To find the dashboard, navigate in Pivotal Cloud Foundry® Apps Manager to the Service Registry service instance's space and click **Manage** in the listing for the service instance.

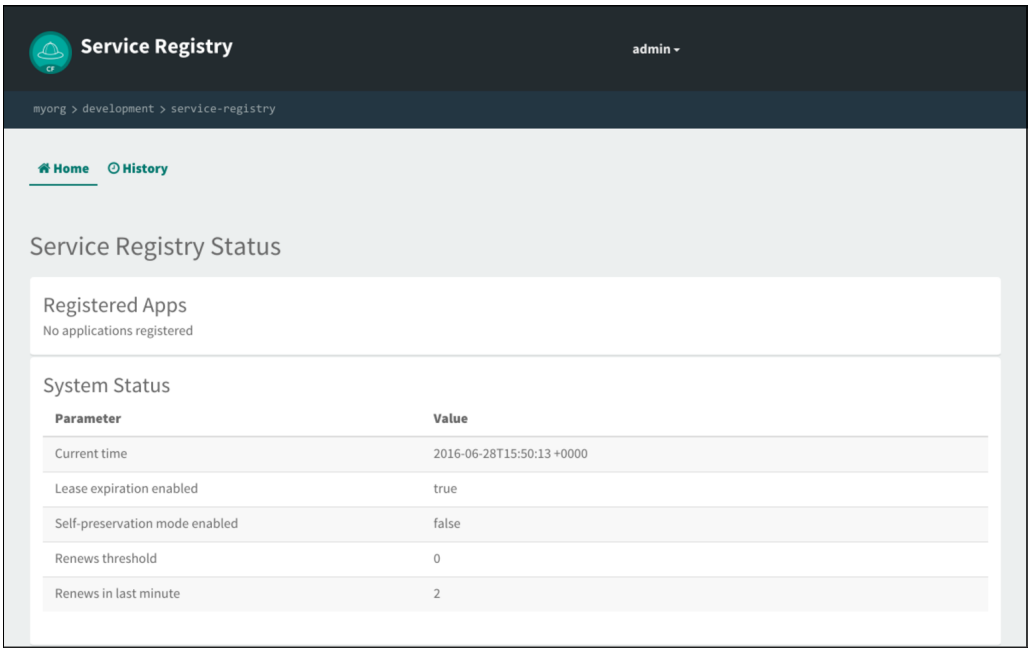


If you are using version 6.8.0 or later of the Cloud Foundry Command Line Interface tool (cf CLI), you can also use `cf service SERVICE_NAME`, where `SERVICE_NAME` is the name of the Service Registry service instance:

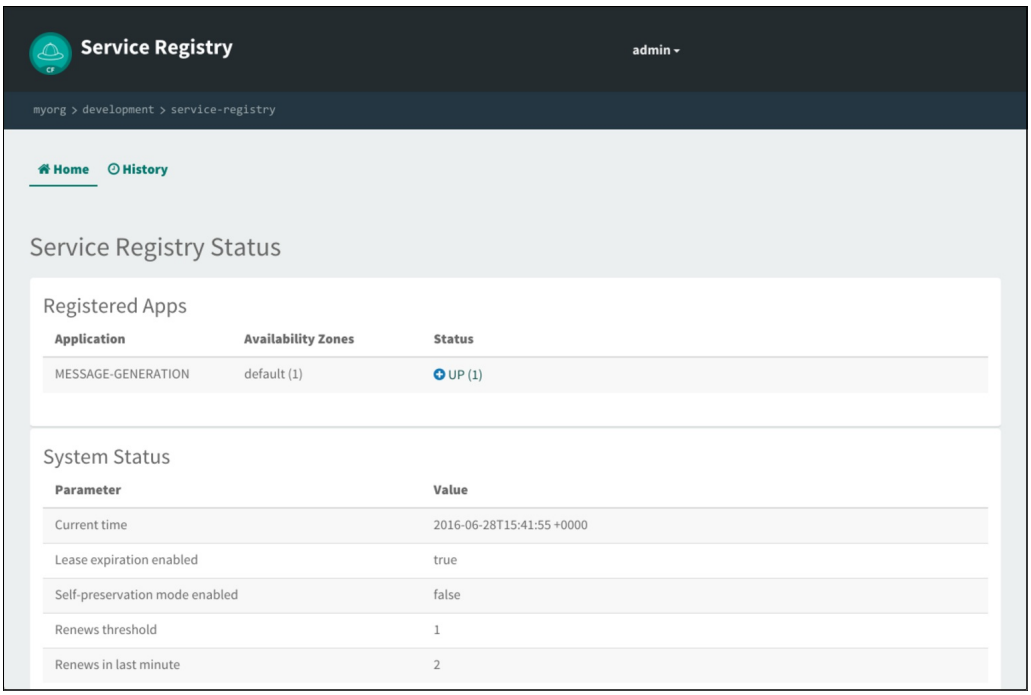
```
$ cf service service registry

Service instance: service-registry
Service: p-service-registry
Bound apps:
Tags:
Plan: standard
Description: Service Registry for Spring Cloud Applications
Documentation url: http://docs.pivotal.io/spring-cloud-services/
Dashboard: https://spring-cloud-broker.wise.com/dashboard/p-service-registry/a9bcaf09-ba0a-4650-bdfc-75784882245e

Last Operation
Status: create succeeded
Message:
Started: 2016-09-19T21:05:32Z
Updated:
```

Visit the URL given for "Dashboard".

Before you have bound any applications to a Service Registry instance, the Service Registry dashboard will reflect that there are "No applications registered".



To see applications listed in the dashboard, bind an application which uses `@EnableDiscoveryClient` to the service instance (see the Writing Client Applications topic). Once you have restaged the application and it has registered with Eureka, the dashboard will display it under **Registered Apps**.



Spring Cloud Connectors

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To connect client applications to the Service Registry, Spring Cloud Services uses Spring Cloud Connectors, including the Spring Cloud Cloud Foundry Connector, which discovers services bound to applications running in Cloud Foundry.

Service Detection

The connector inspects Cloud Foundry's `VCAP_SERVICES` environment variable, which stores connection and identification information for service instances that are bound to Cloud Foundry applications, to detect available services. Below is an example of a `VCAP_SERVICES` entry for the Spring Cloud Services Service Registry.

```
{
 "VCAP_SERVICES": {
  "p-service-registry": [
   {
    "credentials": {
     "access_token_uri": "https://p-spring-cloud-services.uaa.cf.wise.com/oauth/token",
     "client_id": "p-service-registry-57bdc399-5b2e-4131-b941-d0a4275c2da4",
     "client_secret": "GAmFDRU4KGnS",
     "uri": "https://eureka-32fb7386-2d57-4054-91b4-9fd4dcbac221.apps.wise.com"
    },
    "label": "p-service-registry",
    "name": "service-registry",
    "plan": "standard",
    "tags": [
     "eureka",
     "discovery",
     "registry",
     "spring-cloud"
    ]
   }
  ]
```

For each service in the `VCAP_SERVICES` variable, the connector considers the following fields:

- `tags` : Attributes or names of backing technologies behind the service.
- `label` : The service offering's name (not to be confused with a service *instance's* name).
- `credentials.uri` : A URI pertaining to the service instance.
- `credentials.uris` : URIs pertaining to the service instance.

Service Registry Detection Criteria

To establish availability of the Service Registry, the Spring Cloud Cloud Foundry Connector compares `VCAP_SERVICES` service entries against the following criteria:

- `tags` including `eureka`

Application Configuration

In a Spring Boot application which is bound to a Service Registry service instance, the connector automatically configures a Spring Cloud Netflix Eureka client configuration bean. The client configuration includes the discovery zone, which is configured using the URL from the service binding; this is equivalent to setting the `eureka.client.serviceUrl.defaultZone` property.

Eureka Virtual Hostname Configuration

Each Netflix Eureka client application has an insecure virtual hostname, set on the application using the `eureka.instance.virtualHostName` property, and a secure virtual hostname, set on the application using the `eureka.instance.secureVirtualHostname` property. If either of these properties is not set, Spring Cloud Netflix Eureka sets the corresponding virtual hostname to the value of the `spring.application.name` property on the client application.

The Spring Cloud Services connector for Service Registry supplies missing hostname values in the same way. However, if a virtual hostname is not explicitly provided and the connector must derive a hostname from the value of the `spring.application.name` property, the connector sanitizes that value by using a - character to replace any character which is invalid in a hostname.

Important: If you provide a value for either of the `eureka.instance.virtualHostName` or `eureka.instance.secureVirtualHostname` properties, it will not be sanitized, and you must ensure that the value is a valid hostname. The connector sanitizes only virtual hostnames which are derived from the `spring.application.name` property.

Examples of values provided for the `eureka.instance` virtual hostname properties, values provided for the `spring.application.name` property, and the virtual hostnames resulting from combinations of these values or from providing a given value for `spring.application.name` but none for a `eureka.instance` property are listed below.

`eureka.instance` property	`spring.application.name`	Resultant virtual hostname
vhn	san	vhn
v_hn	san	v_hn
(not provided)	san	san

`eureka.instance` property	`spring.application.name`	Resultant virtual hostname
(not provided)	s_an	s-an
x_y	x_y	x_y

See Also

For more information about Spring Cloud Connectors, see the following:

- Spring Cloud Cloud Foundry Connector documentation
- Spring Cloud Spring Service Connector documentation
- Spring Cloud Connectors documentation
- Spring Cloud Connectors for Spring Cloud Services on Pivotal Cloud Foundry

Additional Resources

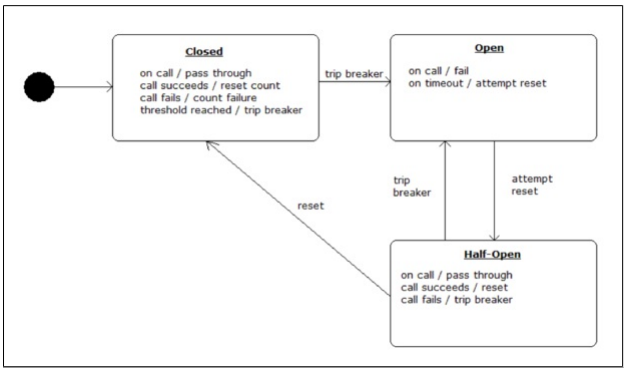
Page last updated:

- Spring Cloud® Services 1.0.0 on Pivotal Cloud Foundry - Service Registry - YouTube (short screencast demonstrating Service Registry for Pivotal Cloud Foundry)
- Home · Netflix/eureka Wiki (documentation for Netflix Eureka, the service registry that underlies Service Registry for Pivotal Cloud Foundry)
- Spring Cloud Netflix (documentation for Spring Cloud Netflix, the open-source project which provides Netflix OSS integrations for Spring applications)
- Microservice Registration and Discovery with Spring Cloud and Netflix's Eureka (discussion and examples of configuring Eureka and Netflix Ribbon using Spring Cloud)
- Client-side service discovery pattern (general description of Service Discovery pattern)
- Service registry pattern (general description of service registry concept)

Circuit Breaker Dashboard for Pivotal Cloud Foundry

Overview

Circuit Breaker Dashboard for Pivotal Cloud Foundry (PCF) provides Spring applications with an implementation of the Circuit Breaker pattern. Cloud-native architectures are typically composed of multiple layers of distributed services. End-user requests may comprise multiple calls to these services, and if a lower-level service fails, the failure can cascade up to the end user and spread to other dependent services. Heavy traffic to a failing service can also make it difficult to repair. Using Circuit Breaker Dashboard, you can prevent failures from cascading and provide fallback behavior until a failing service is restored to normal operation.



When applied to a service, a circuit breaker watches for failing calls to the service. If failures reach a certain threshold, it “opens” the circuit and automatically redirects calls to the specified fallback mechanism. This gives the failing service time to recover.

Circuit Breaker Dashboard for Pivotal Cloud Foundry is based on Hystrix, Netflix’s latency and fault-tolerance library. For more information about Hystrix and about the Circuit Breaker pattern, see Additional Resources.

Refer to the sample applications in the “traveler” repository to follow along with code in this section.

Creating an Instance

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You can create a Circuit Breaker Dashboard service instance using either the Cloud Foundry Command Line Interface tool (cf CLI) or Pivotal Cloud Foundry (PCF) Apps Manager.

Using the cf CLI

Begin by targeting the correct org and space.

```
$ cf target -o myorg -s development

API endpoint:   https://api.cf.wise.com (API version: 2.43.0)
User:           user
Org:            myorg
Space:          development
```

If desired, view plan details for the Circuit Breaker Dashboard product using `cf marketplace -s`.

```
$ cf marketplace
Getting services from marketplace in org myorg / space development as user...
OK

service                    plans          description
p-circuit-breaker-dashboard   standard       Circuit Breaker Dashboard for Spring Cloud Applications
p-config-server               standard       Config Server for Spring Cloud Applications
p-mysql                    100mb-dev      MySQL service for application development and testing
p-rabbitmq                 standard       RabbitMQ is a robust and scalable high-performance multi-protocol messaging broker.
p-service-registry            standard       Service Registry for Spring Cloud Applications

TIP:  Use 'cf marketplace -s SERVICE' to view descriptions of individual plans of a given service.

$ cf marketplace -s p-circuit-breaker-dashboard
Getting service plan information for service p-circuit-breaker-dashboard as user...
OK

service plan   description     free or paid
standard       Standard Plan   free
```

Run `cf create-service`, specifying the service, plan name, and instance name.

```
$ cf create-service p-circuit-breaker-dashboard standard circuit-breaker-dashboard
Creating service instance circuit-breaker-dashboard in org myorg / space development as admin...
OK

Create in progress. Use 'cf services' or 'cf service circuit-breaker-dashboard' to check operation status.
```

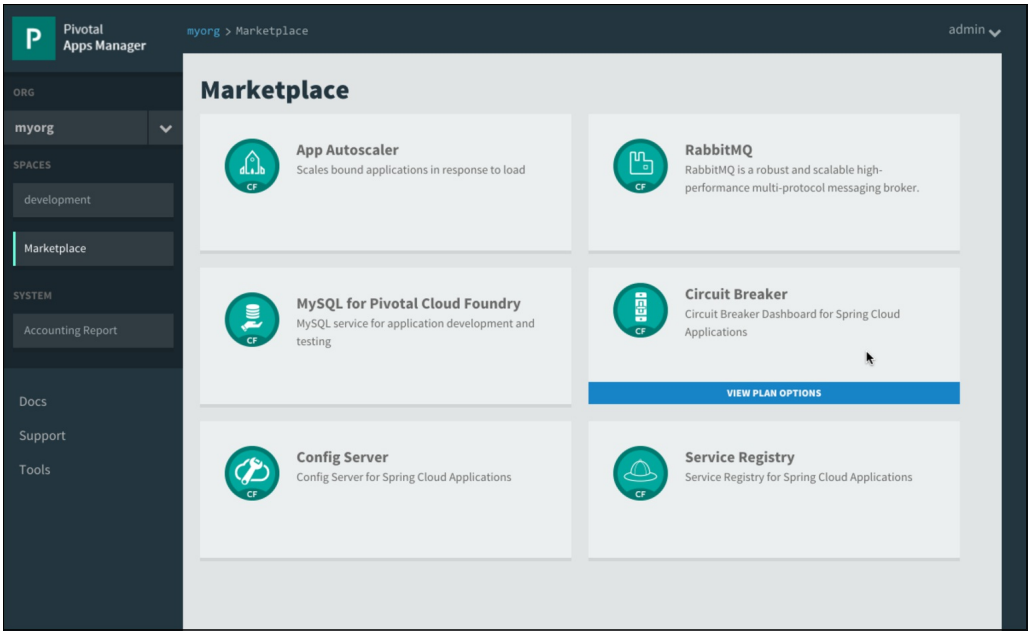
As the command output suggests, you can use the `cf services` or `cf service` commands to check the status of the service instance. When the service instance is ready, the `cf service` command will give a status of `create succeeded`:

```
$ cf service circuit-breaker-dashboard

Service instance: circuit-breaker-dashboard
Service: p-circuit-breaker-dashboard
Bound apps:
Tags:
Plan: standard
Description: Circuit Breaker Dashboard for Spring Cloud® Applications
Documentation url: http://docs.pivotal.io/spring-cloud-services/
Dashboard: https://spring-cloud-broker.apps.wise.com/dashboard/p-circuit-breaker-dashboard/97869d78-5d4e-410b-9c71-bb622ca49f7d

Last Operation
Status: create succeeded
Message:
Started: 2016-06-29T19:13:13Z
Updated: 2016-06-29T19:16:19Z
```

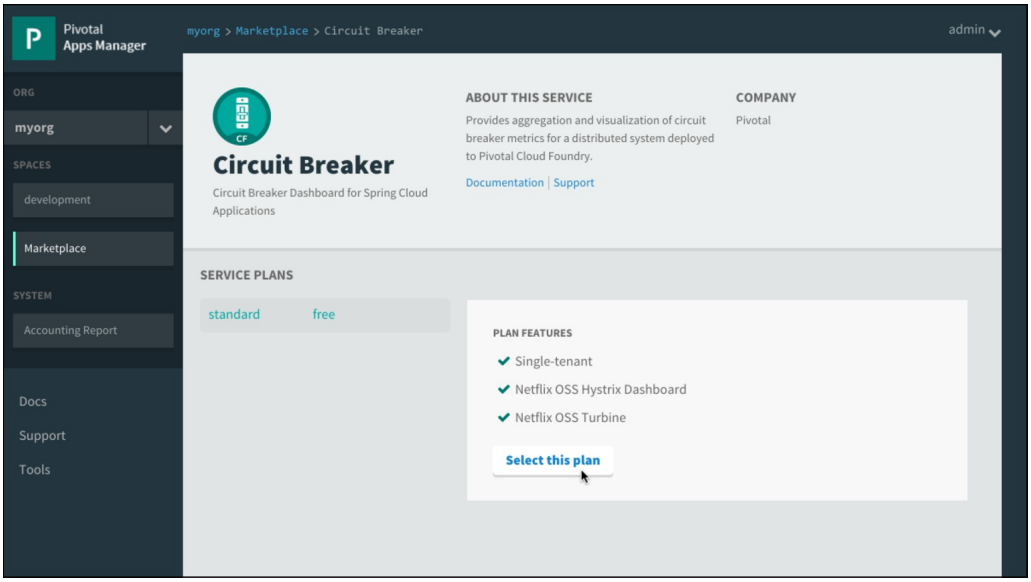
Note: You may notice a discrepancy between the status given for a service instance by the cf CLI (e.g., by the `cf service` command) versus that shown on the Service Instances dashboard. The dashboard is updated frequently (close to real-time); the status retrieved by the cf CLI is not updated as frequently and may take time to match the dashboard.

Using Apps Manager

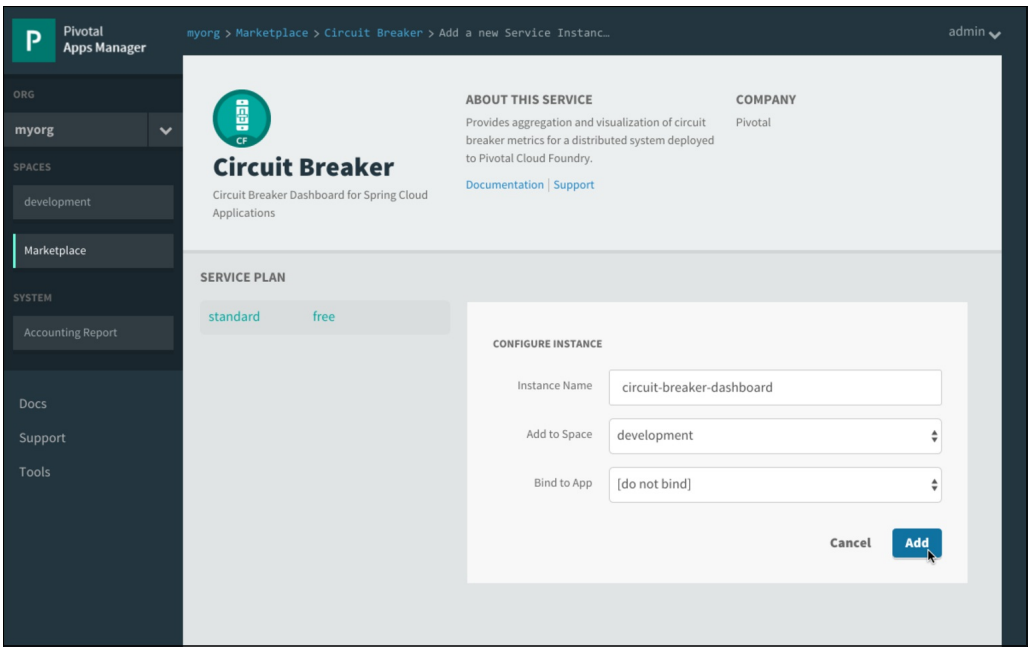
Log into Apps Manager as a Space Developer. In the Marketplace, select **Circuit Breaker**.



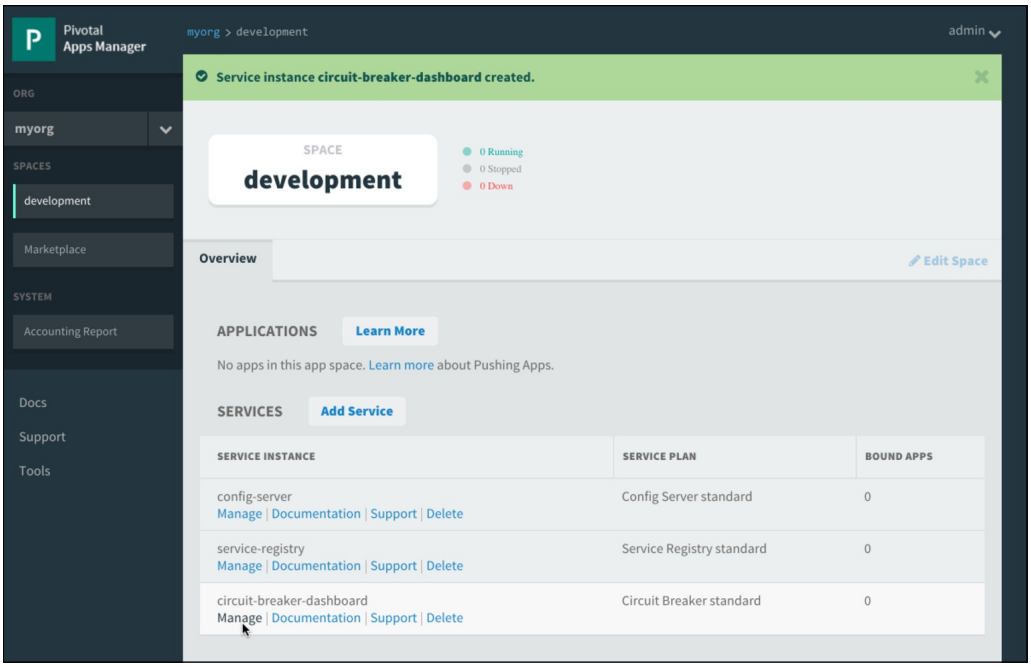
Select the desired plan for the new service instance.



Provide a name for the service instance (for example, “circuit-breaker-dashboard”). Click the **Add** button.



In the **Services** list, click the **Manage** link under the listing for the new service instance.



It may take a few minutes to provision the service instance; while it is being provisioned, you will see a “The service instance is initializing” message. Once the instance is ready, its dashboard will load automatically.

The Circuit Breaker Dashboard instance is now ready to be used. For an example of using a circuit breaker in an application, see the Writing Client Applications topic.

Writing Client Applications

Page last updated:

Refer to the sample applications in the "traveler" repository to follow along with the code in this topic.

To use a circuit breaker in a Spring application with a Circuit Breaker Dashboard service instance, you must add the dependencies listed in the Client Dependencies topic to your application's build file. Be sure to include the dependencies for Circuit Breaker Dashboard as well.

Use a Circuit Breaker

To work with a Circuit Breaker Dashboard instance, your application must include the `@EnableCircuitBreaker` annotation on a configuration class.

```
import org.springframework.cloud.client.circuitbreaker.EnableCircuitBreaker;
//...

@SpringBootApplication
@EnableDiscoveryClient
@RestController
@EnableCircuitBreaker
public class AgencyApplication {
  //...
```

To apply a circuit breaker to a method, annotate the method with `@HystrixCommand`, giving the annotation the name of a `fallbackMethod`.

```
  @HystrixCommand(fallbackMethod = "getBackupGuide")
  public String getGuide() {
    return restTemplate.getForObject("http://company/available", String.class);
  }
```

The `getGuide()` method uses a `RestTemplate` to obtain a guide name from another application called Company, which is registered with a Service Registry instance. (See the Service Registry documentation, specifically the Writing Client Applications topic.) The method thus relies on the Company application to return a response, and if the Company application fails to do so, calls to `getGuide()` will fail. When the failures exceed the threshold, the breaker on `getGuide()` will open the circuit.

While the circuit is open, the breaker redirects calls to the annotated method, and they instead call the designated `fallbackMethod`. The fallback method must be in the same class and have the same method signature (i.e., have the same return type and accept the same parameters) as the annotated method. In the Agency application, the `getGuide()` method on the `TravelAgent` class falls back to `getBackupGuide()`.

```
  String getBackupGuide() {
    return "None available! Your backup guide is: Cookie";
  }
```

If you wish, you may also annotate fallback methods themselves with `@HystrixCommand` to create a fallback chain.

Use a Circuit Breaker with a Feign Client

You cannot apply `@HystrixCommand` directly to a Feign client interface at this time. Instead, you can call Feign client methods from a service class that is autowired as a Spring bean (either through the `@Service` or `@Component` annotations or by being declared as a `@Bean` in a configuration class) and then annotate the service class methods with `@HystrixCommand`.

In the Feign version of the Agency application, the `AgencyApplication` class is annotated with `@EnableFeignClients`.

```
//...
import org.springframework.cloud.netflix.feign.EnableFeignClients;

@SpringBootApplication
@EnableDiscoveryClient
@RestController
@EnableCircuitBreaker
@EnableFeignClients
public class AgencyApplication {
  // ...
```

The application has a Feign client called `CompanyClient`.

```
package agency;

import org.springframework.stereotype.Component;
import org.springframework.cloud.netflix.feign.FeignClient;
import org.springframework.web.bind.annotation.RequestMapping;

import static org.springframework.web.bind.annotation.RequestMethod.GET;

@FeignClient("https://company")
interface CompanyClient {
  @RequestMapping(value="/available", method = GET)
  String availableGuide();
}
```

The `TravelAgent` class is annotated as a `@Service` class. The `CompanyClient` class is injected through autowiring, and the `getGuide()` method uses the `CompanyClient` to access the Company application. `@HystrixCommand` is applied to the service method:

```
package agency;

import org.springframework.stereotype.Service;
import org.springframework.beans.factory.annotation.Autowired;

import com.netflix.hystrix.contrib.javanica.annotation.HystrixCommand;

@Service
public class TravelAgent {

   @Autowired
   CompanyClient company;

   @HystrixCommand(fallbackMethod = "getBackupGuide")
   public String getGuide() {
      return company.availableGuide();
   }

   String getBackupGuide() {
      return "None available! Your backup guide is: Cookie";
   }

}
```

If the Company application becomes unavailable or if the Agency application cannot access it, calls to `getGuide()` will fail. When successive failures build up to the threshold, Hystrix will open the circuit, and subsequent calls will be redirected to the `getBackupGuide()` method until the Company application is accessible again and the circuit is closed.

Using the Dashboard

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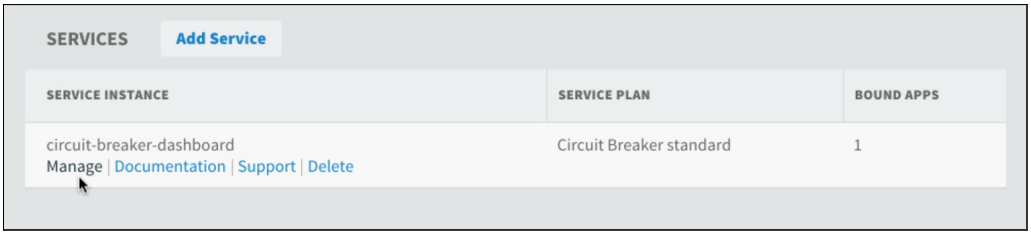
To find the dashboard, navigate in Pivotal Cloud Foundry® Apps Manager to the Circuit Breaker Dashboard service instance's space and click **Manage** in the listing for the service instance.



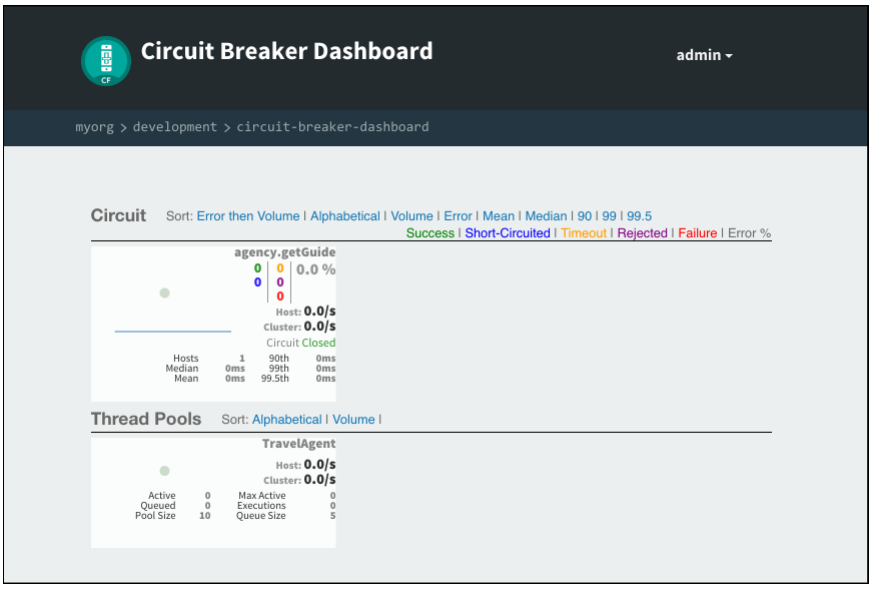
If you are using version 6.8.0 or later of the Cloud Foundry Command Line Interface (cf CLI), you can also use `cf service SERVICE_NAME`, where `SERVICE_NAME` is the name of the Circuit Breaker Dashboard service instance:

```
$ cf service circuit-breaker-dashboard

Service instance: circuit-breaker-dashboard
Service: p-circuit-breaker-dashboard
Bound apps: agency
Tags:
Plan: standard
Description: Circuit Breaker Dashboard for Spring Cloud Applications
Documentation url: http://docs.pivotal.io/spring-cloud-services/
Dashboard: https://spring-cloud-broker.apps.wise.com/dashboard/p-circuit-breaker-dashboard/97869d78-5d4e-410b-9c71-bb622ca49f7d

Last Operation
Status: create succeeded
Message:
Started: 2016-06-29T19:13:13Z
Updated: 2016-06-29T19:16:19Z
```

Visit the URL given for "Dashboard".

To see breaker statuses on the dashboard, configure an application as described in the Writing Client Applications topic, using `@HystrixCommand` annotations to apply circuit breakers. Then push the application and bind it to the Circuit Breaker Dashboard service instance. Once bound and restaged, the application will update the dashboard with metrics that describe the health of its monitored service calls.

With the "Agency" example application (see the "traveler" repository) receiving no load, the dashboard displays the following:

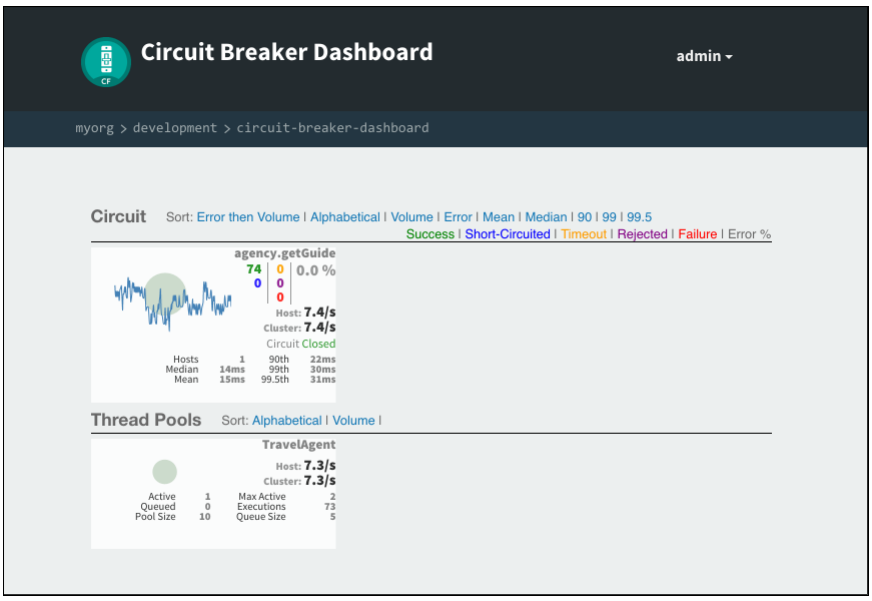


To see the circuit breaker in action, use curl, JMeter, Apache Bench, or similar to simulate load.

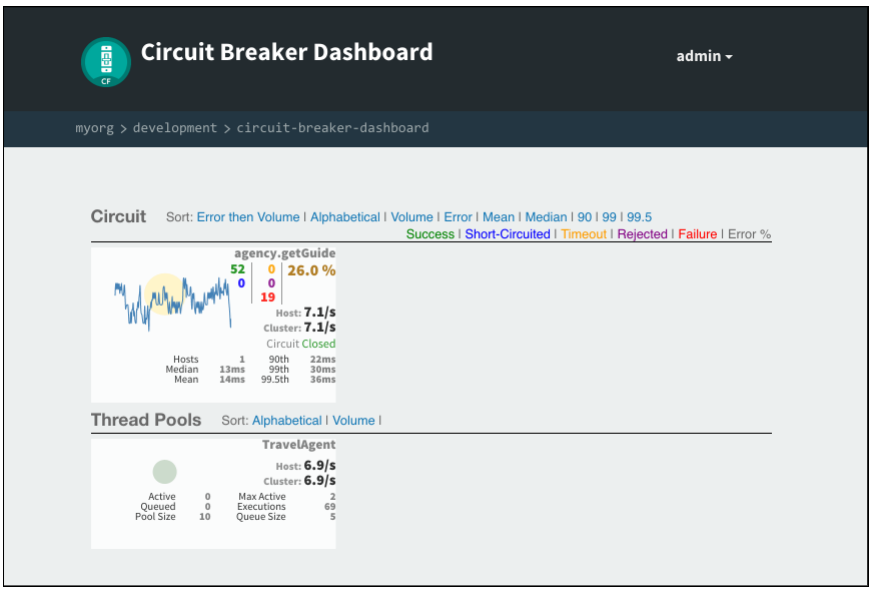
```
$ while true; do curl agency.apps.wise.com; done
```

With the Company application running and available via the Service Registry instance (see the Writing Client Applications topic), the Agency application responds with a guide name, indicating a successful service call. If you stop Company, Agency will respond with a "None available" message, indicating that the call to its `getGuide()` method failed and was redirected to the fallback method.

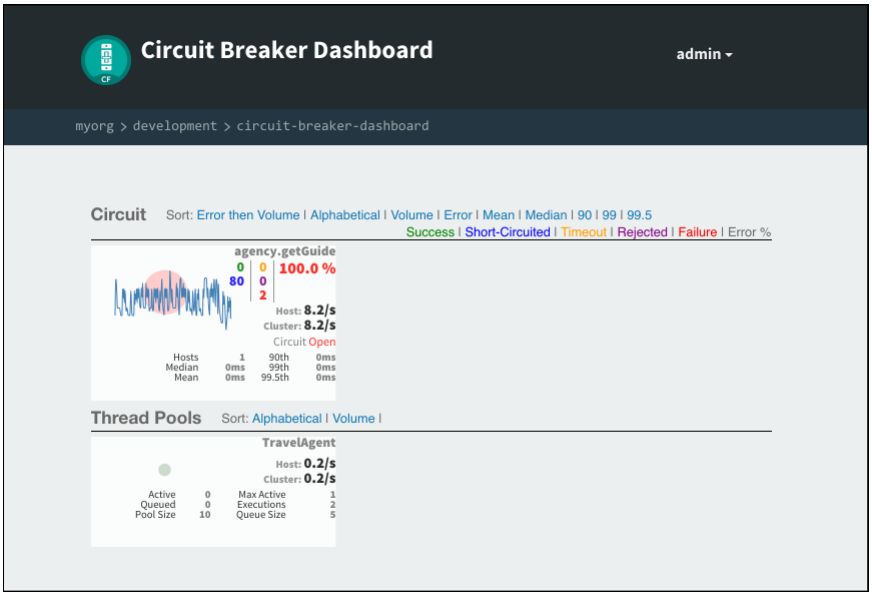
When service calls are succeeding, the circuit is closed, and the dashboard graph shows the rate of calls per second and successful calls per 10 seconds.



When calls begin to fail, the graph shows the rate of failed calls in red.



When failures exceed the configured threshold (the default is 20 failures in 5 seconds), the breaker opens the circuit. The dashboard shows the rate of short-circuited calls—calls which are going straight to the fallback method—in blue. The application is still allowing calls to the failing method at a rate of 1 every 5 seconds, as indicated in red; this is necessary to determine if calls are succeeding again and if the circuit can be closed.



With the circuit breaker in place on its `getGuide()` method, the Agency example application never returns an HTTP status code other than `200` to the requester.

Spring Cloud® Connectors

Page last updated:

To connect client applications to the Circuit Breaker Dashboard, Spring Cloud Services uses Spring Cloud Connectors, including the Spring Cloud Cloud Foundry Connector, which discovers services bound to applications running in Cloud Foundry.

Service Detection

The connector inspects Cloud Foundry's `VCAP_SERVICES` environment variable, which stores connection and identification information for service instances that are bound to Cloud Foundry applications, to detect available services. Below is an example excerpt of a `VCAP_SERVICES` entry for the Spring Cloud Services Circuit Breaker Dashboard (edited for brevity).

```
{
 "VCAP_SERVICES": {
  "p-circuit-breaker-dashboard": [
   {
    "credentials": {
     "dashboard": "https://hystrix-67b8d606-c287-4fb1-9b3f-bd5cb27a29b5.apps.wise.com",
     "stream": "https://turbine-67b8d606-c287-4fb1-9b3f-bd5cb27a29b5.apps.wise.com"
    },
    "label": "p-circuit-breaker-dashboard",
    "name": "circuit-breaker-dashboard",
    "plan": "standard",
    "tags": [
     "circuit-breaker",
     "hystrix-amqp",
     "spring-cloud"
    ]
   }
  ]
```

For each service in the `VCAP_SERVICES` variable, the connector considers the following fields:

- `tags` : Attributes or names of backing technologies behind the service.
- `label` : The service offering's name (not to be confused with a service *instance's* name).
- `credentials.uri` : A URI pertaining to the service instance.
- `credentials.uris` : URIs pertaining to the service instance.

Circuit Breaker Dashboard Detection Criteria

To establish availability of the Circuit Breaker Dashboard, the Spring Cloud Cloud Foundry Connector compares `VCAP_SERVICES` service entries against the following criteria:

- `tags` including `hystrix-amqp`

Metrics Collection with Spring Cloud Stream

A Circuit Breaker Dashboard service instance uses Spring Cloud Stream to collect Netflix Hystrix metrics from a client application. The connector creates a `hystrix` configuration of the Spring Cloud Stream RabbitMQ binder and configures a `hystrixStreamOutput` channel, over which a client application sends Hystrix metrics.

The `defaultCandidate` property on the `hystrix` RabbitMQ binder configuration is set to `false`, so that this binder configuration will not affect any default binder configuration in the client application and you can freely configure Spring Cloud Stream binders (including the RabbitMQ binder) in the client application. For more information, see "Connecting to Multiple Systems" in the Spring Cloud Stream Reference Guide.

See Also

For more information about Spring Cloud Connectors, see the following:

- Spring Cloud Cloud Foundry Connector documentation
- Spring Cloud Spring Service Connector documentation
- Spring Cloud Connectors documentation
- Spring Cloud Connectors for Spring Cloud Services on Pivotal Cloud Foundry

Additional Resources

Page last updated:

- Spring Cloud® Services 1.0.0 on Pivotal Cloud Foundry - Circuit Breaker - YouTube (short screencast demonstrating Circuit Breaker Dashboard for Pivotal Cloud Foundry)
- Home · Netflix/Hystrix Wiki (documentation for Netflix Hystrix, the library that underlies Circuit Breaker Dashboard for Pivotal Cloud Foundry)
- Spring Cloud Netflix (documentation for Spring Cloud Netflix, the open-source project which provides Netflix OSS integrations for Spring applications)
- CircuitBreaker (article in Martin Fowler's Bliki about the Circuit Breaker pattern)
- The Netflix Tech Blog: Introducing Hystrix for Resilience Engineering (Netflix Tech introduction of Hystrix)
- The Netflix Tech Blog: Making the Netflix API More Resilient (Netflix Tech description of how Netflix's API used the Circuit Breaker pattern)
- SpringOne2GX 2014 Replay: Spring Boot and Netflix OSS (59:54 in the video begins an introduction of Hystrix and a Spring Cloud demo)