Lab : Scaling and Connecting Your Services - Load balancing

In this episode, we will look in greater detail at the process of deploying, scaling, and connecting your applications. You have already learned the basic information about deploying services to the OpenShift cloud. Now it's time to extend this knowledge and learn how to use it in practice.

Let's start with deployments.

Important:

Before starting this guide, complete these openshift labs here

Pre-reqs:

- Openshift Wildfly Lab

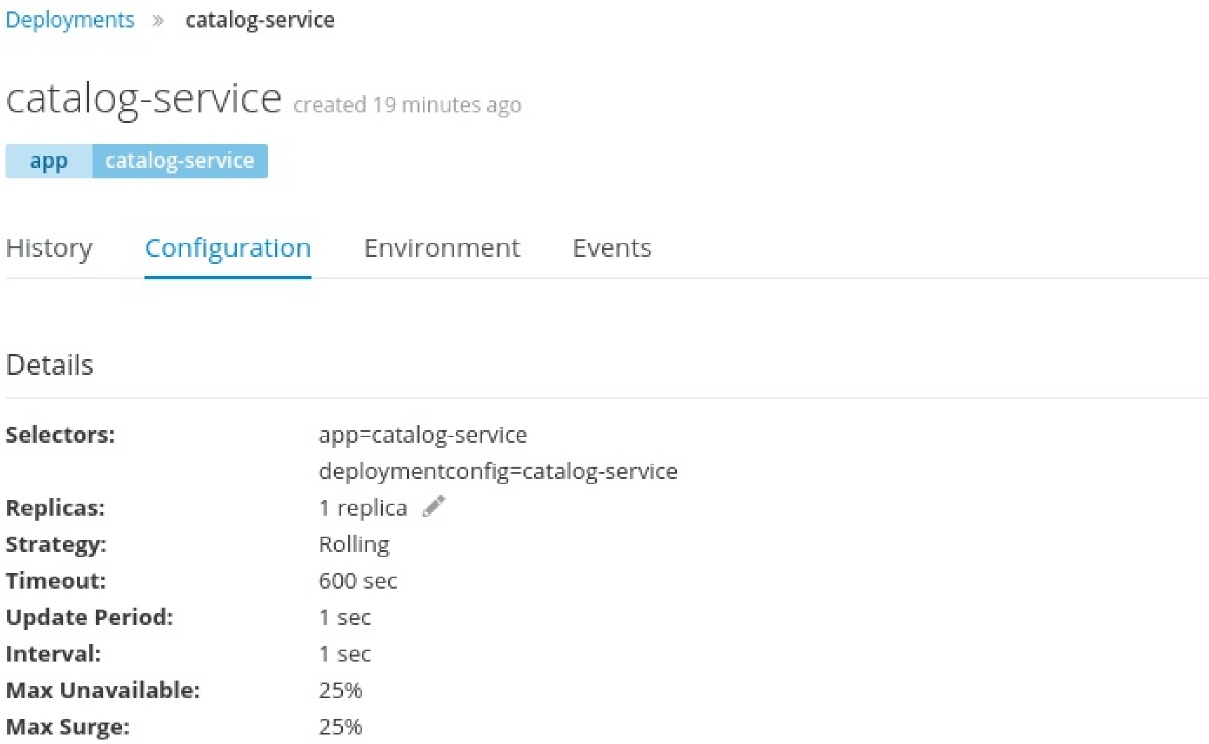
Deployments

Let's examine what happens under the hood during deployment of our services. We are going to continue work on an example from the previous chapter.

Note

Examples reference: `chapter8/catalog-service-openshift-load-balancing`.

You have to open the web console, and navigate to **`Applications`** | **`Deployments`** | **`catalog-service`**:



Now we will be able to see the deployment configuration. This is the graphical representation of OpenShift's `DeploymentConfiguration` object.

OpenShift adds another layer on top of Kubernetes to provide a more convenient and productive programmer experience. It does that, among other things, by extending the object model of Kubernetes. `DeploymentConfiguration` and **`Deployments`** are OpenShift objects that extend the Kubernetes object model.

The `DeploymentConfiguration` object manages the creation of the **`Deployments`** objects. It contains all the necessary information to create **`Deployments`**, which, as its name suggests, represents an instance of deployment. When one of the Deployments triggers happens, the old deployment object is replaced by the new one. All of the deployment objects are based on `DeploymentConfiguration`. **`Deployments`**, among others, encapsulate Kubernetes's `ReplicationController` object. Let's understand it in greater detail.

Learning the basics of ReplicationController

`ReplicationController` contains the following information: the pod template, selector, and the number of replicas. Let's examine those further.

The pod template is basically a pod definition. It contains information about the containers, volumes, ports, and labels. Every pod created by this replication controller will be started using this pod template. The selector is used to determine which pods are governed by this `ReplicationController`. Finally, the number of replicas is the number of pods that we want to be running.

Kubernetes works in the following way: it monitors the current state of the cluster, and if that state is different from the desired state it takes actions so that the desired state is restored. The same thing happens with `ReplicationControllers`. `ReplicationController` continuously monitors the number of pods that are associated with it. If the number of the pods is different than the desired number, it starts or stops pods so that the desired state is restored. The pod is started using the pod template.

Let's examine the `ReplicationController` that Kubernetes created for our catalog-service. To do this, we will use the CLI:

```
[tomek@localhost ~]$ oc get replicationcontrollers -l app=catalog-service
NAME                DESIRED   CURRENT   READY     AGE
catalog-service-1   0         0         0         21m
catalog-service-2   0         0         0         5m
catalog-service-3   1         1         1         5m
[tomek@localhost ~]$
```

As you will notice in the preceding screenshot, there are three replication controllers created for **`catalog-service`**. This is the case because of each redeployment of the application results in the creation of a new deployment object with its own replication controller. Note that only **`catalog-service-3`** has the desired number of instances greater than **`0`**—the previous deployments have been made inactive when the new deployment was taking place.

Let's take a look at the description of the active controller:

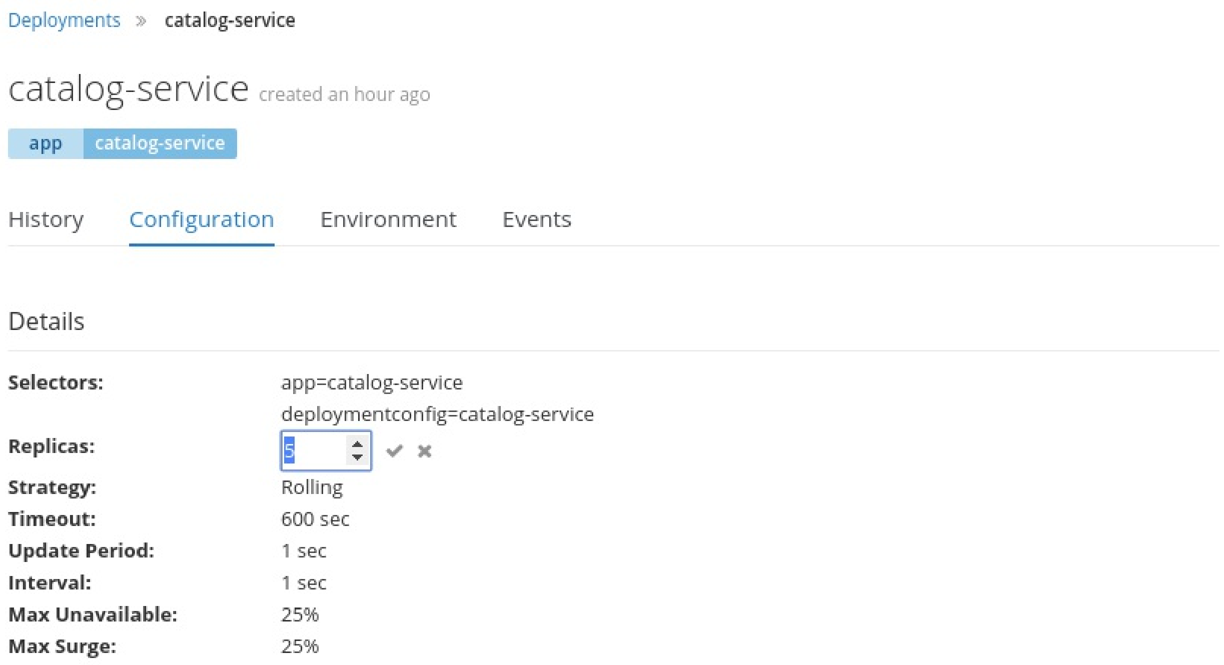
```
[tomek@localhost ~]$ oc describe replicationcontroller/catalog-service-3
Name:           catalog-service-3
Namespace:      petstore
Selector:       app=catalog-service,deployment=catalog-service-3,deploymentconfig=catalog-service
Labels:         app=catalog-service
                openshift.io/deployment-config.name=catalog-service
Annotations:    openshift.io/deployer-pod.name=catalog-service-3-deploy
                openshift.io/deployment-config.latest-version=3
                openshift.io/deployment-config.name=catalog-service
                openshift.io/deployment.phase=Complete
                openshift.io/deployment.replicas=
                openshift.io/deployment.status-reason=manual change
                openshift.io/encoded-deployment-config={"kind":"DeploymentConfig","apiVersion":"v1","metadata":{"name":"catalog-service"
,"namespace":"petstore","selfLink":"/apis/apps.openshift.io/v1/namespaces/petsto...
Replicas:       1 current / 1 desired
Pods Status:    1 Running / 0 Waiting / 0 Succeeded / 0 Failed
Pod Template:
  Labels:       app=catalog-service
                deployment=catalog-service-3
                deploymentconfig=catalog-service
  Annotations:  openshift.io/deployment-config.latest-version=3
                openshift.io/deployment-config.name=catalog-service
                openshift.io/deployment.name=catalog-service-3
                openshift.io/generated-by=OpenShiftWebConsole
  Containers:
   catalog-service:
    Image:      tadamski/catalog-service@sha256:b40765874ca3adb7f7d2fb06b8a8b10a9ebc485f6fd9ee502c05070e0984fe55
    Ports:      8080/TCP, 8778/TCP, 9779/TCP
    Environment:
      POSTGRESQL_HOST:          172.30.199.153
      POSTGRESQL_USER:          petstore
      POSTGRESQL_PASSWORD:      XyIpmjEWlXCQnPsG
      POSTGRESQL_SCHEMA:        petstoredb
    Mounts:                     <none>
  Volumes:                      <none>
Events:
  FirstSeen     LastSeen        Count   From                    SubObjectPath   Type            Reason                  Message
  ---------     --------        -----   ----                    -------------   --------        ------                  -------
  12m           12m             1       replication-controller                  Normal          SuccessfulCreate        Created pod: cat
alog-service-3-3kr44
```

The selector has threelabels: app, deployment, and deployment-config. It unambiguously identifies the pods associated with the given deployment.

Note

Exactly the same labels are used in the pod template. Other parts of the pod template contain the image from which the container is built, and the environment variables that we provided during the creation of the service. Finally, the number of current and desired replicas is set, by default, to one.

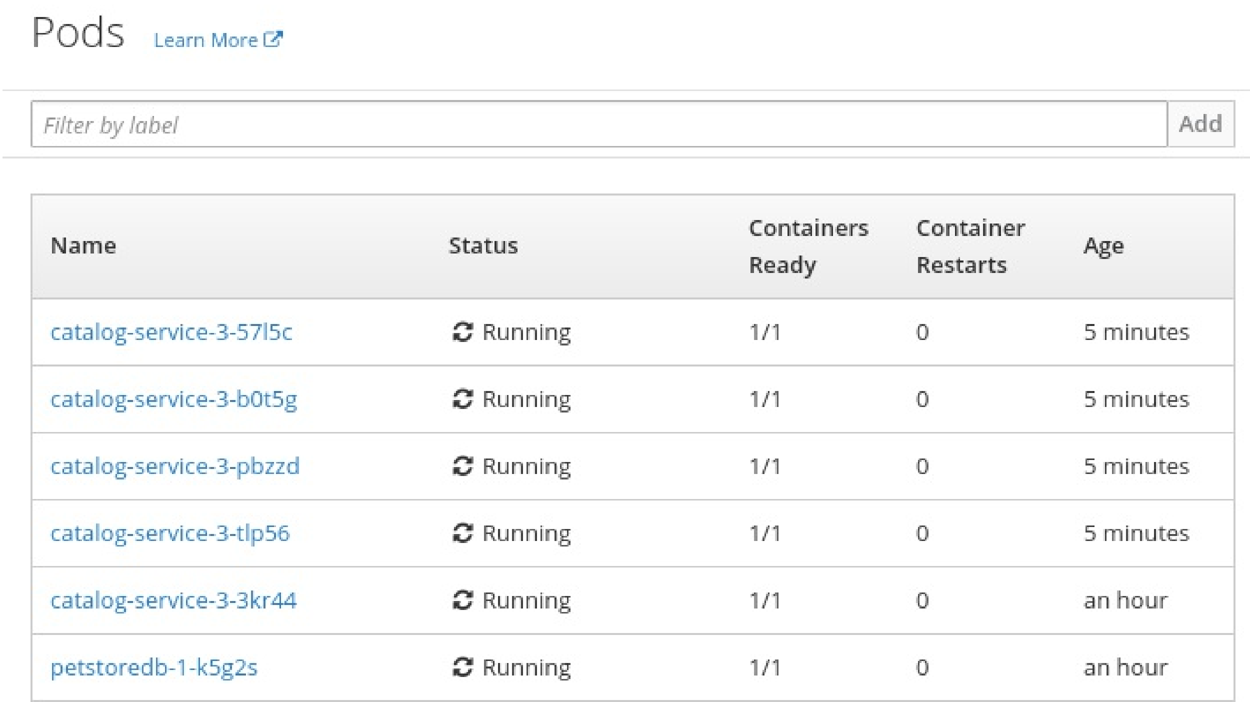
OK. So how do we scale our service so that it runs on more than one instance? Let's move to the web console again. We need to navigate to `Application` | `Deployments` again and enter the `catalog-service` configuration:



To scale the `catalog-service` application, we have to adjust the `Replicas` field to the number of instances that we want to have. That's it.

When we look at the `ReplicationControllers` in the `oc`, we will see the following information:

The number of pods has been changed to `5`. As we saw in the `oc` output, additional pods have been started and we now have five instances. Let's check in the console (navigate to `Applications` | `Pods`):



Pods Learn More

Filter by label Add

Name	Status	Containers Ready	Container Restarts	Age
catalog-service-3-57l5c	Running	1/1	0	5 minutes
catalog-service-3-b0t5g	Running	1/1	0	5 minutes
catalog-service-3-pbzzd	Running	1/1	0	5 minutes
catalog-service-3-tlp56	Running	1/1	0	5 minutes
catalog-service-3-3kr44	Running	1/1	0	an hour
petstoredb-1-k5g2s	Running	1/1	0	an hour

OpenShift has indeed scaled our application according to our needs.

OpenShift builds an effective and easy-to-use application development environment on top of Kubernetes. The preceding example showed how it works very well: Kubernetes is responsible for making sure that the state of the cluster equals the description provided. In the preceding example, this description is provided by a `ReplicationController` object (which is part of the Kubernetes object model). Note, however, that OpenShift has abstracted away all the nitty-gritty details from us. We have only provided the information such as the address of the code repository or number of replicas that we want to have. The OpenShift layer abstracts away the technical details of cluster configuration and provides us with convenient, easy-to-use tools, which allow the programmer to concentrate on the development.

Let's return to our main topic. The next thing that we will configure is **load balancing**.

Load balancing

We have just learned how to scale our service. The next natural step is to configure the load balancer. The good news is that OpenShift will do most of the stuff automatically for us.

Openshift service is reached using a virtual cluster IP. To understand how load balancing works, let's understand how cluster IP is implemented.

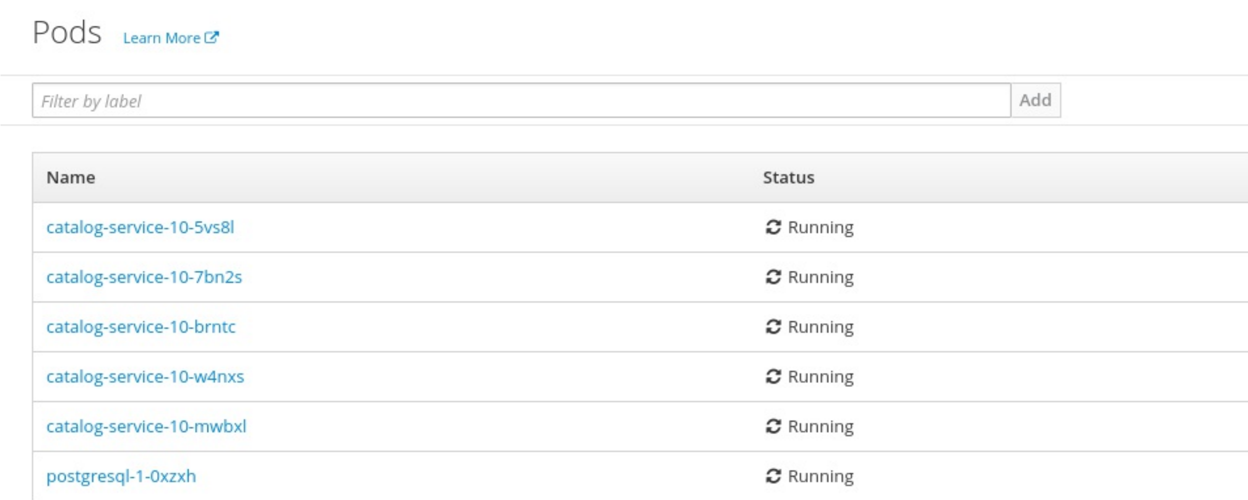
As we have also learned here, each node in a Kubernetes cluster runs a bunch of services, which allow a cluster to provide its functionality.

One of those services is **kube-proxy**. Kube-proxy runs on every node and is, among other things, responsible for service implementation. Kube-proxy continuously monitors the object model describing the cluster and gathers information about currently active services and pods on which those services run. When the new service appears, kube-proxy modifies the iptables rules so that the virtual cluster's IP is routed to one of the available pods. The iptables rules are created so that the choice of the pod is random. Also, note that those IP rules have to be constantly rewritten to match the current state of the cluster.

A kube-proxy runs on every node of the cluster. Owing to that, on each node, there is a set of iptables rules, which forward the package to the appropriate pods. As a result, the service is accessible from each node of the cluster on its virtual cluster IP.

What's the implication of that from the client service perspective? The cluster infrastructure is hidden from the service client. The client doesn't need to have any knowledge about nodes, pods, and their dynamic movement inside the cluster. They just invoke the service using its IP as if it was a physical host.

Let's return to our example and look at the load balancing of our host. Let's return to the example in which we are working within this episode. We statically scaled our catalog service to five instances. Let's enter the web console in order to look at all the pods on which the application currently runs:



Let's trace to which pods are the requests forwarded. In order to achieve that, we implemented a simple REST filter:

```
package org.packt.swarm.petstore.catalog;

import javax.ws.rs.container.ContainerResponseFilter;
import javax.ws.rs.container.ContainerRequestContext;
import javax.ws.rs.container.ContainerResponseContext;
import javax.ws.rs.ext.Provider;
import java.io.IOException;

//1
@Provider
public class PodNameResponseFilter implements ContainerResponseFilter {
public void filter(ContainerRequestContext req, ContainerResponseContext res)
```

```
throws IOException
    {
//2
        res.getHeaders().add("pod",System.getenv("HOSTNAME"));
}
}
```

The preceding filter adds a `"pod"` property to the response headers. The filter will be evaluated after the response is processed (1). On each pod, there is a `"HOSTNAME"` environment variable set. We can use this variable and add it to the response metadata (2).

Let's run our new application:

```
oc delete all -l app=catalog-service
```

```
oc new-app wildflyswarm-10-centos7~https://github.com/PacktPublishing/Hands-On-Cloud-Development-with-WildFly.git --context-dir=chapter8/catalog-service-openshift-load-balancing/ --name=catalog-service
```

```
oc expose svc/catalog-service
```

```
oc scale --replicas=3 dc catalog-service
```

As a result, we are ready to trace the load balancing:

```
[tomek@localhost ~]$ curl -I http://catalog-service-petstore.192.168.42.48.nip.io/
item/fc7ee3ea-8f82-4144-bcc8-9a71f4d871bd
HTTP/1.1 200 OK
pod: catalog-service-1-8842l
Content-Type: application/json
Content-Length: 206
Date: Sun, 18 Mar 2018 13:37:00 GMT
Set-Cookie: 143a3872a836a2875d0e32fb7af4450c=a096c3835f5eb25fa681fcc839e114f0; pat
h=/; HttpOnly
Cache-control: private

[tomek@localhost ~]$ curl -I http://catalog-service-petstore.192.168.42.48.nip.io/
item/fc7ee3ea-8f82-4144-bcc8-9a71f4d871bd
HTTP/1.1 200 OK
pod: catalog-service-1-sq05t
Content-Type: application/json
Content-Length: 206
Date: Sun, 18 Mar 2018 13:37:07 GMT
Set-Cookie: 143a3872a836a2875d0e32fb7af4450c=246506eedb4cfc092f2862ddf4df4fc9; pat
h=/; HttpOnly
Cache-control: private

[tomek@localhost ~]$ curl -I http://catalog-service-petstore.192.168.42.48.nip.io/
item/fc7ee3ea-8f82-4144-bcc8-9a71f4d871bd
HTTP/1.1 200 OK
pod: catalog-service-1-zlb85
Content-Type: application/json
Content-Length: 206
Date: Sun, 18 Mar 2018 13:37:10 GMT
Set-Cookie: 143a3872a836a2875d0e32fb7af4450c=c511a0b6fb50bac9bfb43165db52909d; pat
h=/; HttpOnly
Cache-control: private

[tomek@localhost ~]$ curl -I http://catalog-service-petstore.192.168.42.48.nip.io/
item/fc7ee3ea-8f82-4144-bcc8-9a71f4d871bd
HTTP/1.1 200 OK
pod: catalog-service-1-rcd42
Content-Type: application/json
Content-Length: 206
Date: Sun, 18 Mar 2018 13:37:11 GMT
Set-Cookie: 143a3872a836a2875d0e32fb7af4450c=3b42672ae622d5ba049a797c69e2ecc8; pat
h=/; HttpOnly
Cache-control: private

[tomek@localhost ~]$ curl -I http://catalog-service-petstore.192.168.42.48.nip.io/
item/fc7ee3ea-8f82-4144-bcc8-9a71f4d871bd
HTTP/1.1 200 OK
pod: catalog-service-1-qznz9
Content-Type: application/json
Content-Length: 206
Date: Sun, 18 Mar 2018 13:37:12 GMT
Set-Cookie: 143a3872a836a2875d0e32fb7af4450c=15303f0b3403ed17f9d3790998eb63da; pat
h=/; HttpOnly
Cache-control: private

[tomek@localhost ~]$
```

Run this command multiple times in the terminal:

```
catalog-service-petstore.<update-me>-80-<update-me>.environments.katacoda.com/item/dbf67f4d-f1c9-4fd4-96a8-65ee1a22b9ff
```

In the preceding screenshot, note that the request is being automatically load balanced among the available pods.