Chapter 4:
Kubernetes OpenShift

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OpenShift Introduction

What is OpenShift

- Kubernetes is an excellent at orchestrating and scheduling containers

But for “APPLICATION” deployment, there’s more needed

- OpenShift provides an excellent **platform** for developing, deploying and running applications.
- A **layer** on top of Docker and Kubernetes that makes it accessible and easy for developers to create applications

Ways to interact with OpenShift

- **Web Console**

Web based GUI for all aspects of developing a project and is full of features

- **Command Line Interface**

Written in "*Go*", the tool is called "*oc*", is a single binary executable provided for all major operating systems, and it can be used to perform any operation that can be accomplished via the web console

- **Rest APIs**

Web-console and CLI talks via Rest API, which can be used by users mostly to automate through code

Features of OpenShift

All features are same in Web console and the CLI

- Scale the application containers
- Create projects
- View log files
- View the memory and CPU utilization of a container
- Easy build docker images and deploy application with few clicks

Features of OpenShift

Source-to-Image (S2I) - Open source project by the OpenShift team

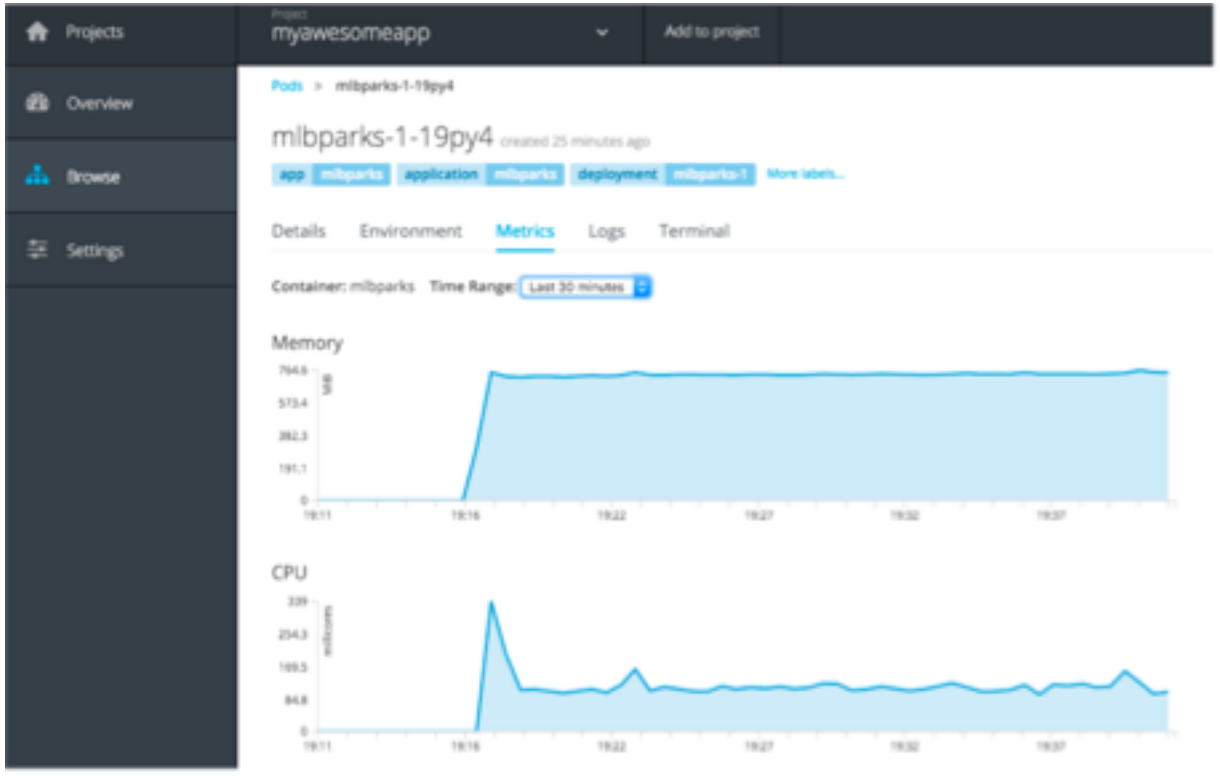
- No need to write dockerfiles or build Docker images
- Works directly with source code (e.g. github URL)
- Needs base image and CMD when container starts, rest is done by S2I

e.g. Scenario: Java app in Git, using maven build system, depends on Tomcat webserver. S2I will download the base tomcat image, clone the repo, identify it as a maven project, run a maven build, take the artifact, creates a new docker image containing tomcat webserver and project artifact, deploy the build artifact and start the container

Features of OpenShift

Integrate logs and metrics

- **Logs:-** OpenShift provides a comprehensive view of application logs – runtime logs, build logs, deployment logs – accessible using web-console and CLI
- **Metrics:-** Application metrics, utilization of system resources, memory and CPU utilization for all containers

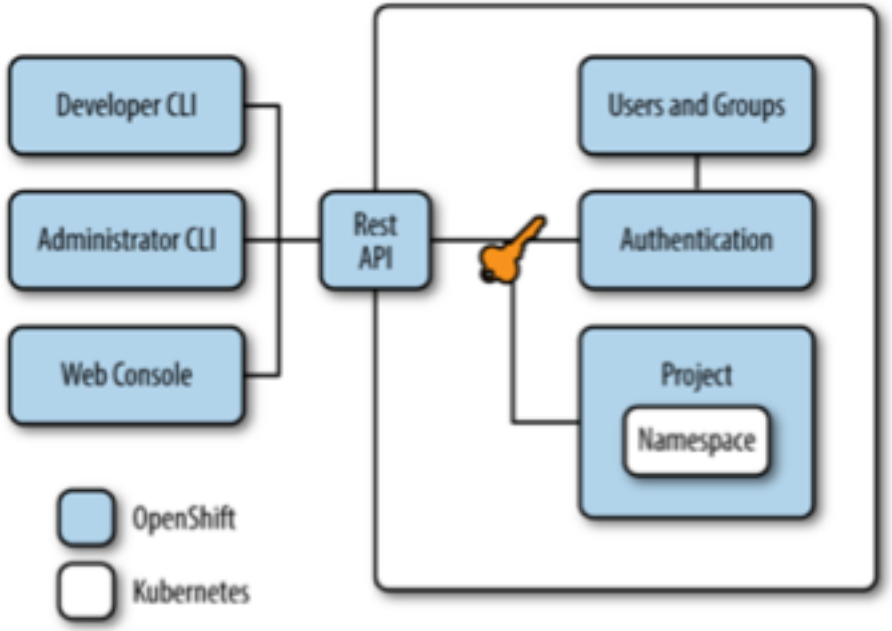


OpenShift “Projects”

Kubernetes use *Namespace* to divide cluster resources between multiple uses. There is no security between namespaces, Being a user in k8s cluster, you can see all namespaces.

Project

- Project wraps a namespace, with access controlled through an authentication model
- Users can only see and access what they are allowed to
- Enables multitenant



OpenShift “Applications”

OpenShift has no formal concept of an Application.

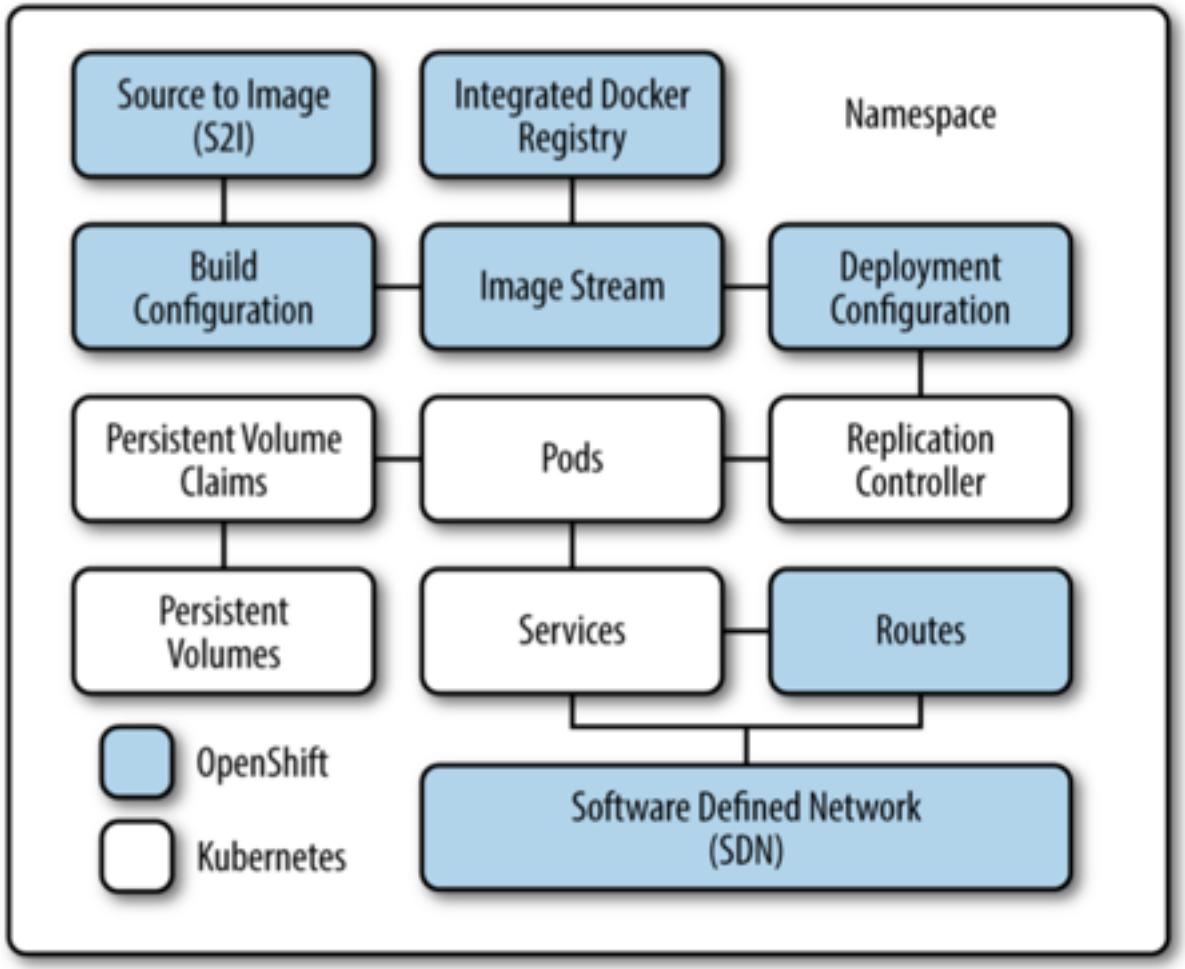
It’s flexible based on need.

Build configuration: description of how to build source code. It can be either S2I or directly a docker image

Image stream: Tracks Docker image and it’s versions. You can refer to an existing Docker registry, if present

Deployment configuration: defines the template for a pod and manages deploying new images or configuration changes. All kinds of deployment strategy goes here and this creates replicationcontroller.

Fig. different parts goes in for an application



OpenShift Deployment and “DeploymentConfig”

Deployments provide management over common user applications, described using :

- **Deployment configuration**, describes the desired state of a particular component of the application.
- **Replication controllers**, which contain the state of a deployment configuration.
- **Pods**

What’s different than Kubernetes Deployment ?

Triggers: drive the creation of new deployments in response to events, both inside and outside OpenShift.

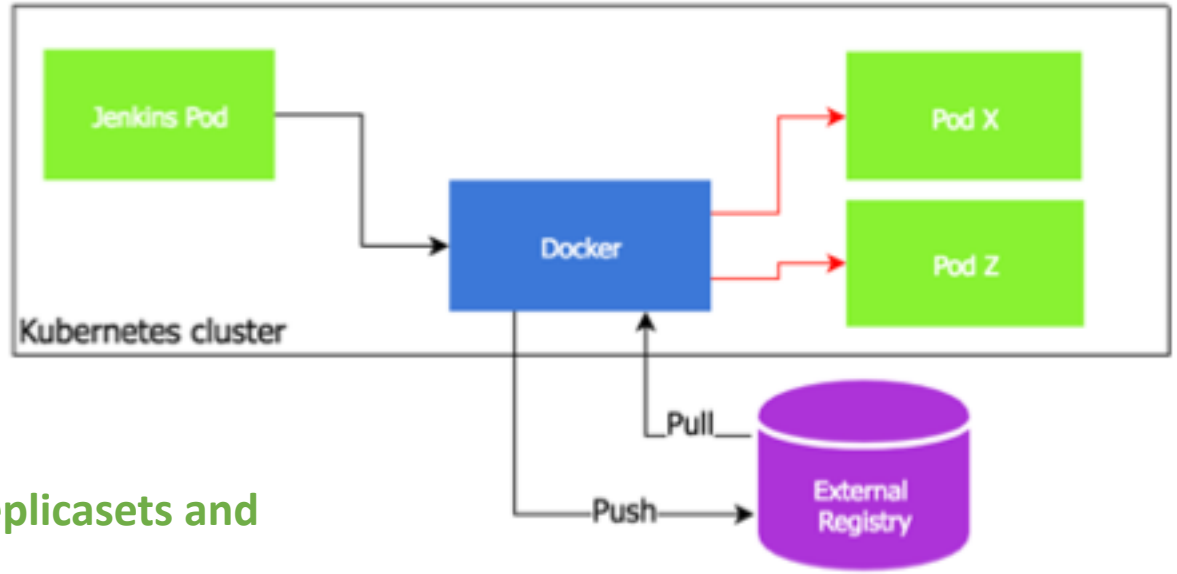
- Config change trigger – changes in replication controller template
- Image change trigger

  oc import-image foo --scheduled

OpenShift “ImageStream”

Kubernetes requires to have an image registry to store images.

Need to expose docker socket directly to build agent (e.g. Jenkins) which is a **security risk** - this agent will be able to do anything with other containers running on the same host



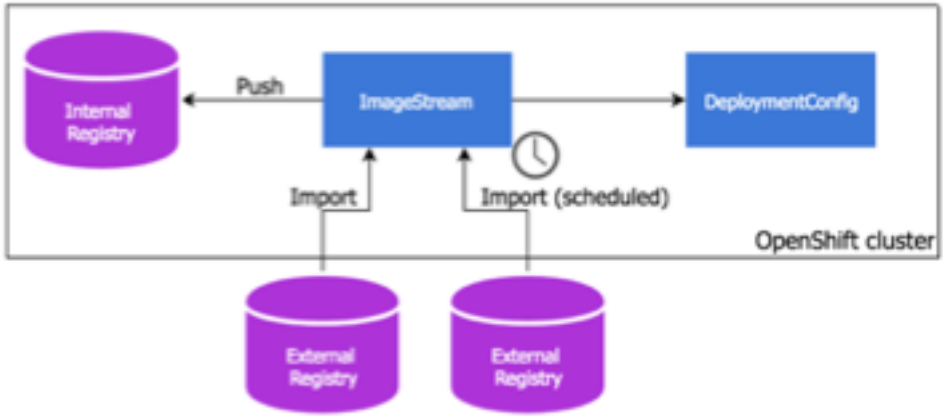
Can we create images the same way as we create pods, replicasets and other resources?

K8s doesn’t have {image} resource unlike OpenShift.

Manage Images with BuildConfig and “ImageStream”

- fetch files from git repository
- build a container image based on *Dockerfile* definition from that repo
- push *foo:latest* built image to *ImageStreamTag* object
- Image pushed to OpenShift *internal registry*
- ImageStreamTags objects are references to individual container images kept in internal or external registries

```
apiVersion: v1
kind: BuildConfig
metadata:
  name: foo-build
spec:
  source:
    git:
      uri: "git@git.example.com:foo.git"
    type: Git
  strategy:
    dockerStrategy:
      noCache: true
  output:
    to:
      kind: ImageStreamTag
      name: foo:latest
```



OpenShift “Build” and “BuildConfig”

Build - Transform input parameters into a resulting object, mostly into a runnable container image.

BuildConfig - Config describing the strategy of a build. The build strategies are:

- Source-to-Image (S2I)
  - Force Pull
  - Incremental
- Pipeline - Jenkins pipeline for execution
  - Provide jenkinsfile in the build config
  - Provide jenkinsfile in a git repo and use git repo in the build config
- Docker – Invokes Docker build, thus expects dockerfile with all required artifact
  - Provide Dockerfile
  - Provide docker image location

OpenShift Build Triggers

In BuildConfig, triggers can be defined to control the circumstances in which the BuildConfig should be run. The following build triggers are available:

- **Webhook** - Trigger a new build by sending a request using push events from Github, GitLab, Bitbucket. In case of any change in Git repo, a new build will be created
- **Image Change** – when a new image is found
- **Configuration Change** – only when new BuildConfig is created. in future versions; updates in BuildConfig will also trigger a new build

Trigger can be set/removed

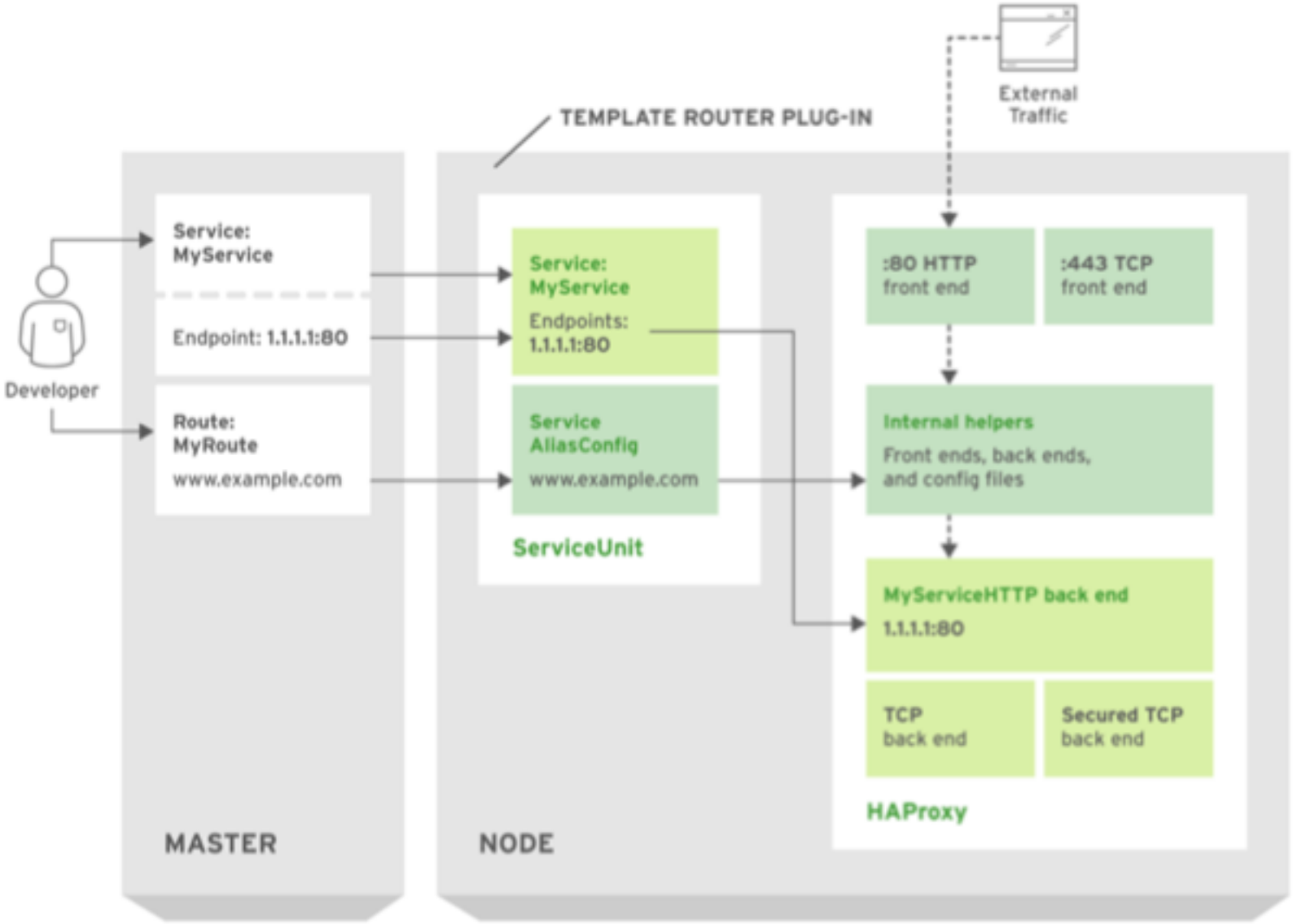
```
oc set triggers bc <name> --from-github
oc set triggers bc <name> --from-image='<image>'
```

OpenShift concept of “Routes”

- Expose a service by giving it an externally-reachable hostname - www.example.com
- Route and the endpoints is consumed by a **router** (HAProxy, F-5 are supported by default) to provide named connectivity that allows external clients to reach applications
- Each route consists of a route name (max 63 characters), service selector, and (optional) security configuration.

oc expose svc/frontend --hostname=www.example.com --port 8080

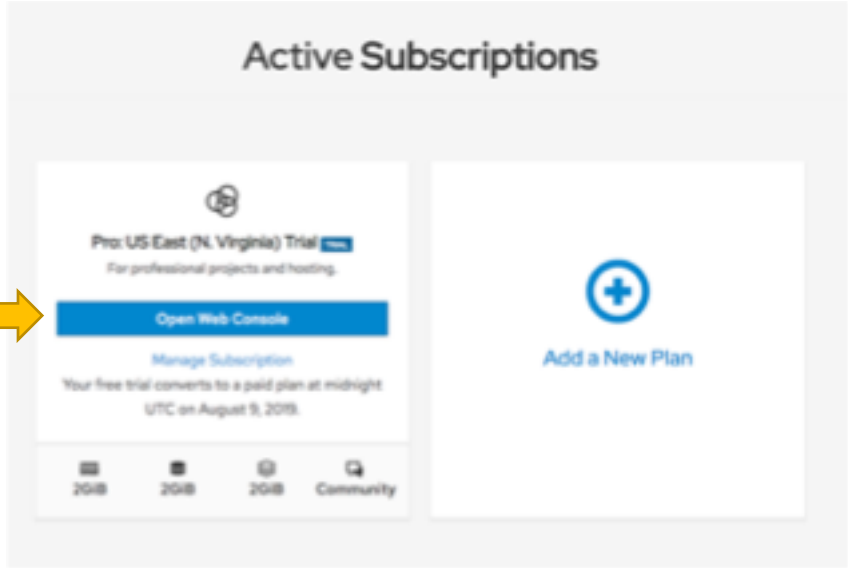
HAProxy Router Data Flow



OpenShift Online – labs

OpenShift Online Login

- Login OpenShift Online at https://manage.openshift.com/
  - User id: osonline.test1@gmail.com
  - Password: JustM300
- Open Web Console



This will take you to the web console of OpenShift cluster

OpenShift
- Web Console labs

Ex 1: Deploy Application – Web Console (Using Image)

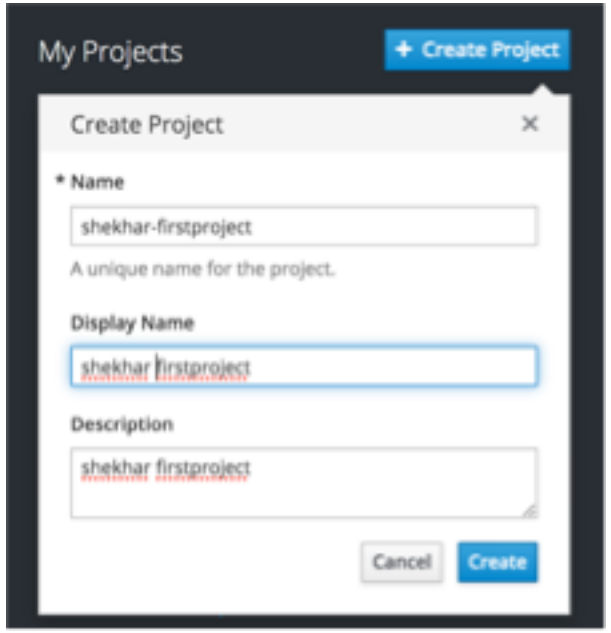
- Steps to execute

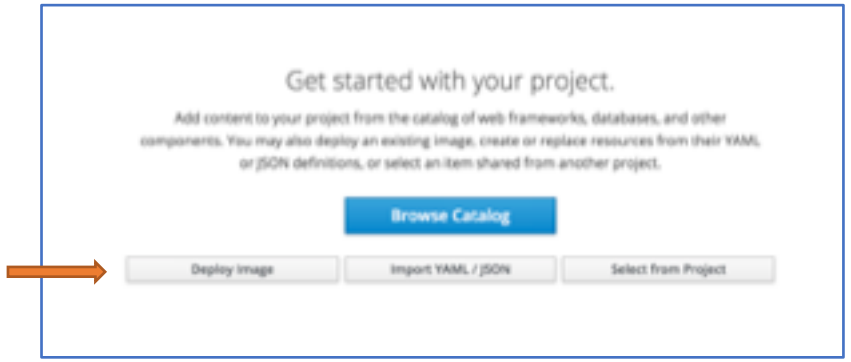
Steps:

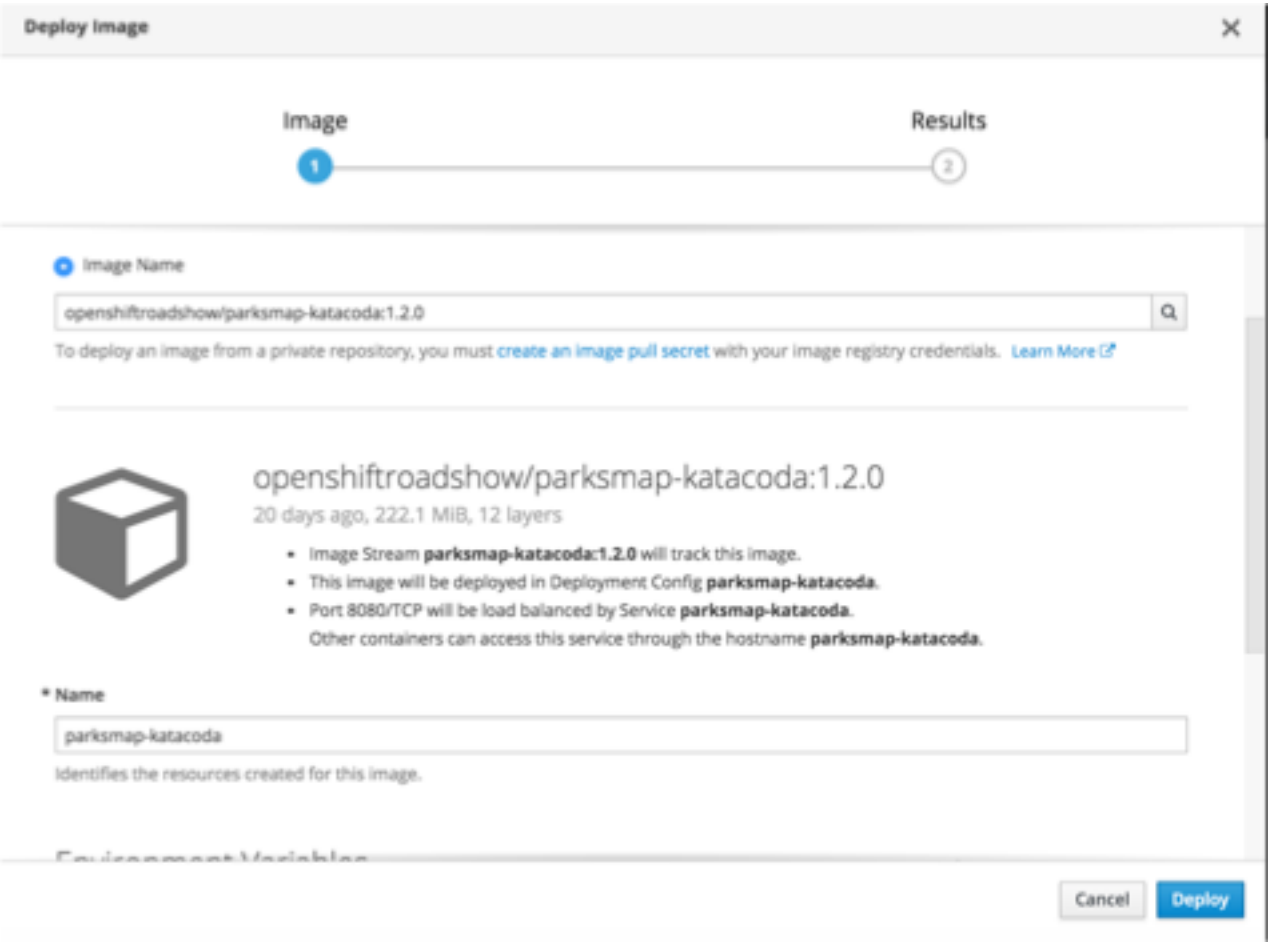
- Create project **<your-name>-firstproject**
- Deploy from image – with image "**openshiftroadshow/parksmap-katacoda:1.2.0**"
- Scale up pod; Check logs; Check events
- Check Image Stream
- Create route to expose external service

Ex 1: Deploy Application – Web Console (Using Image)

- Steps in UI

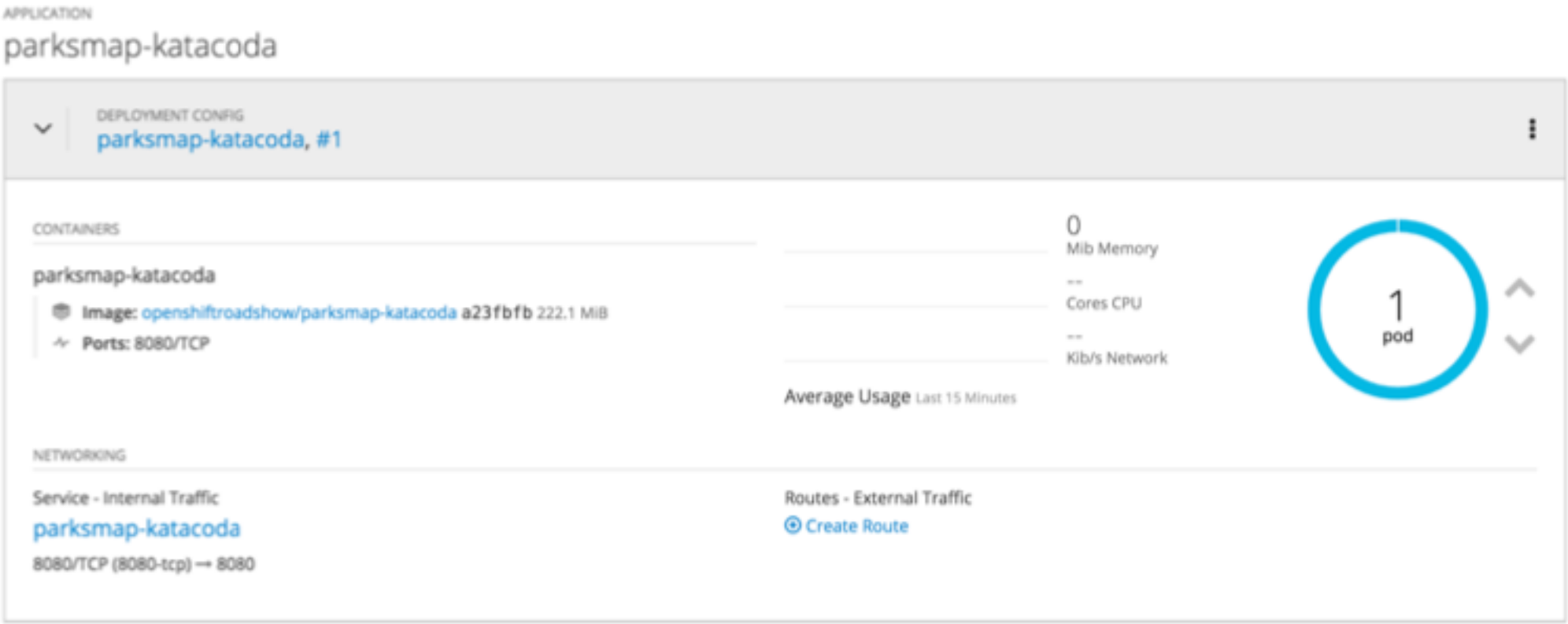






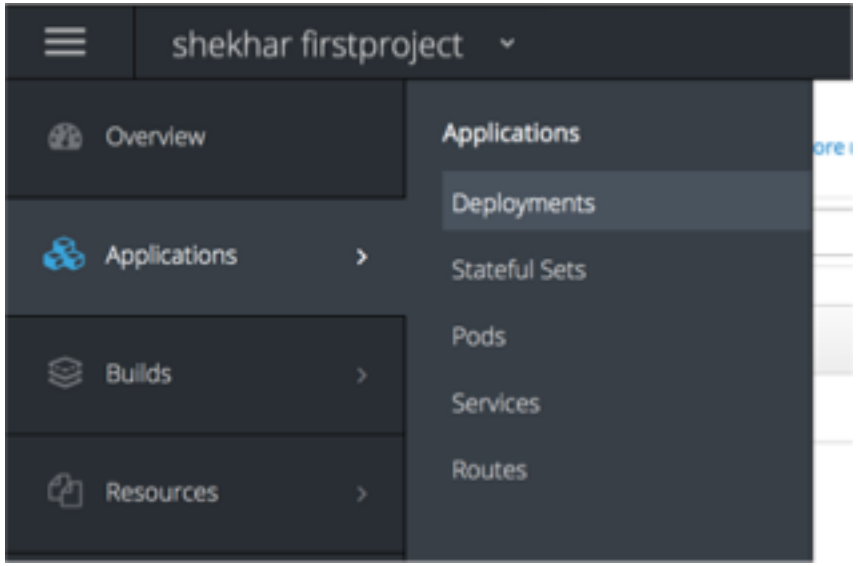
Ex 1: Deploy Application – Web Console (Using Image)

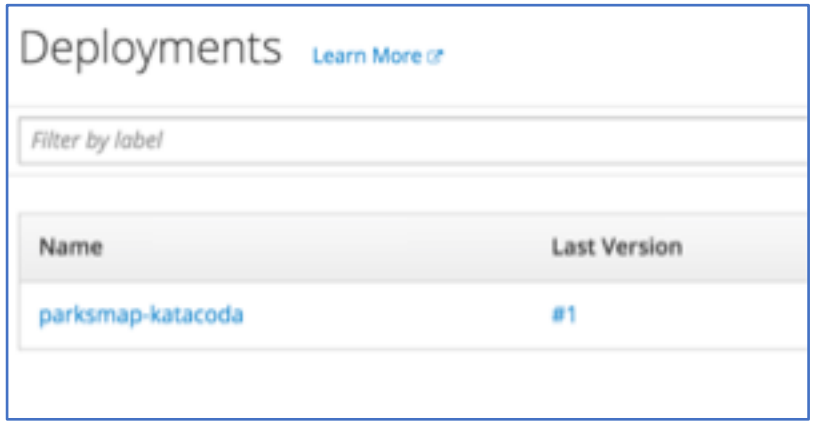
- Project overview

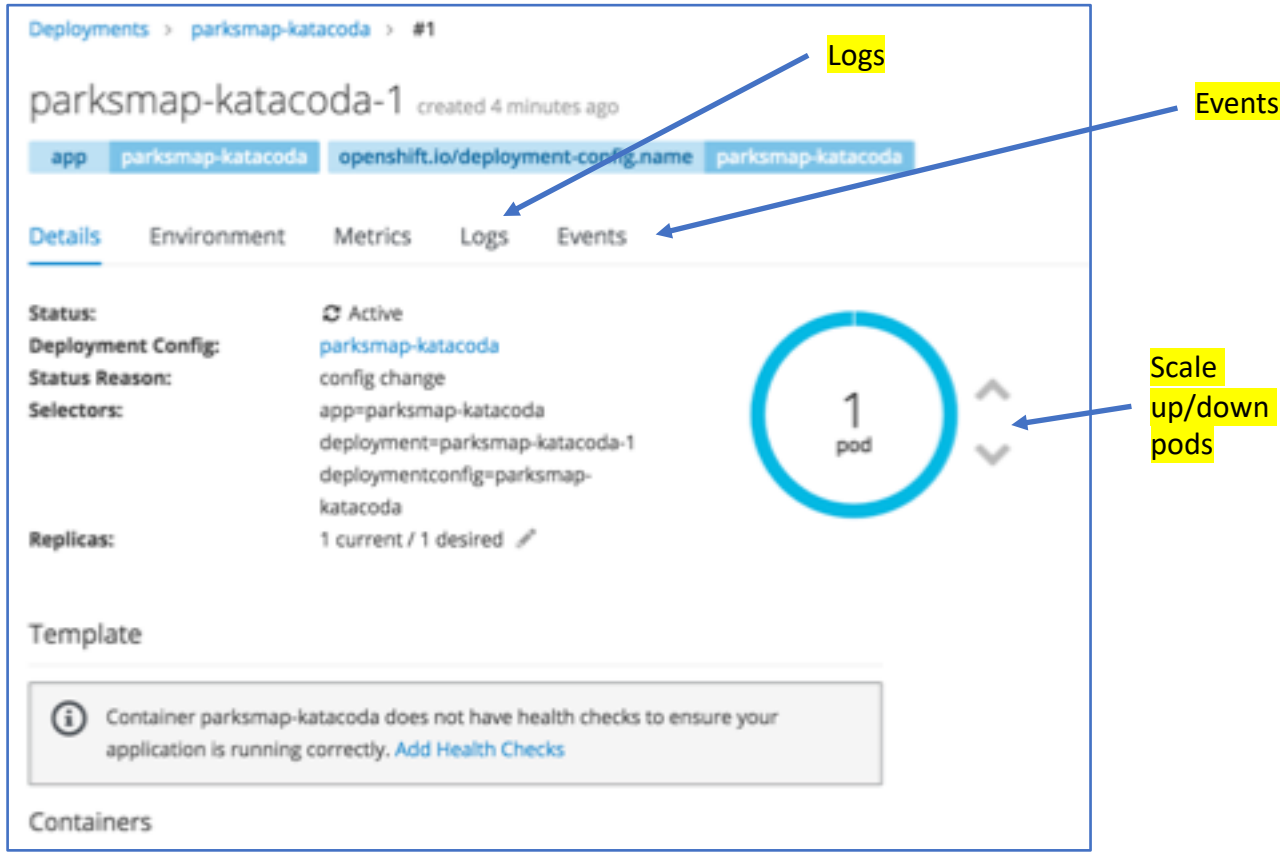


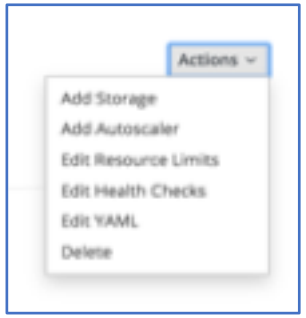
Ex 1: Deploy Application – Web Console (Using Image)

- Deployment



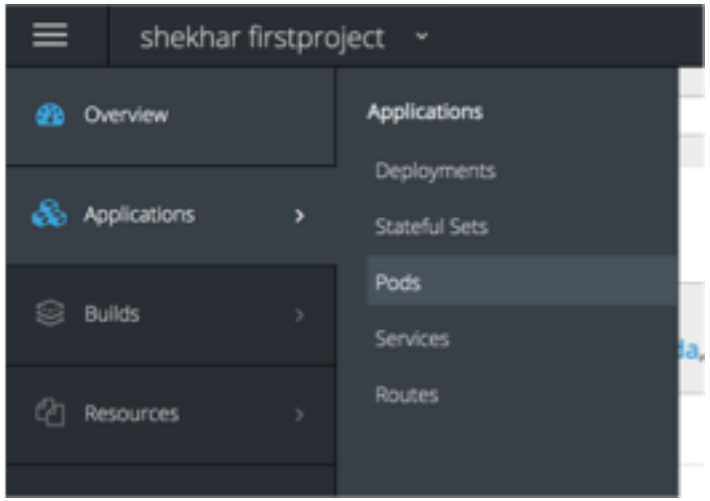


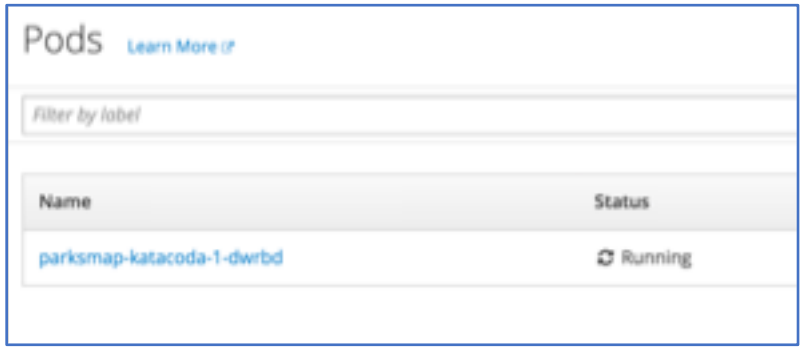


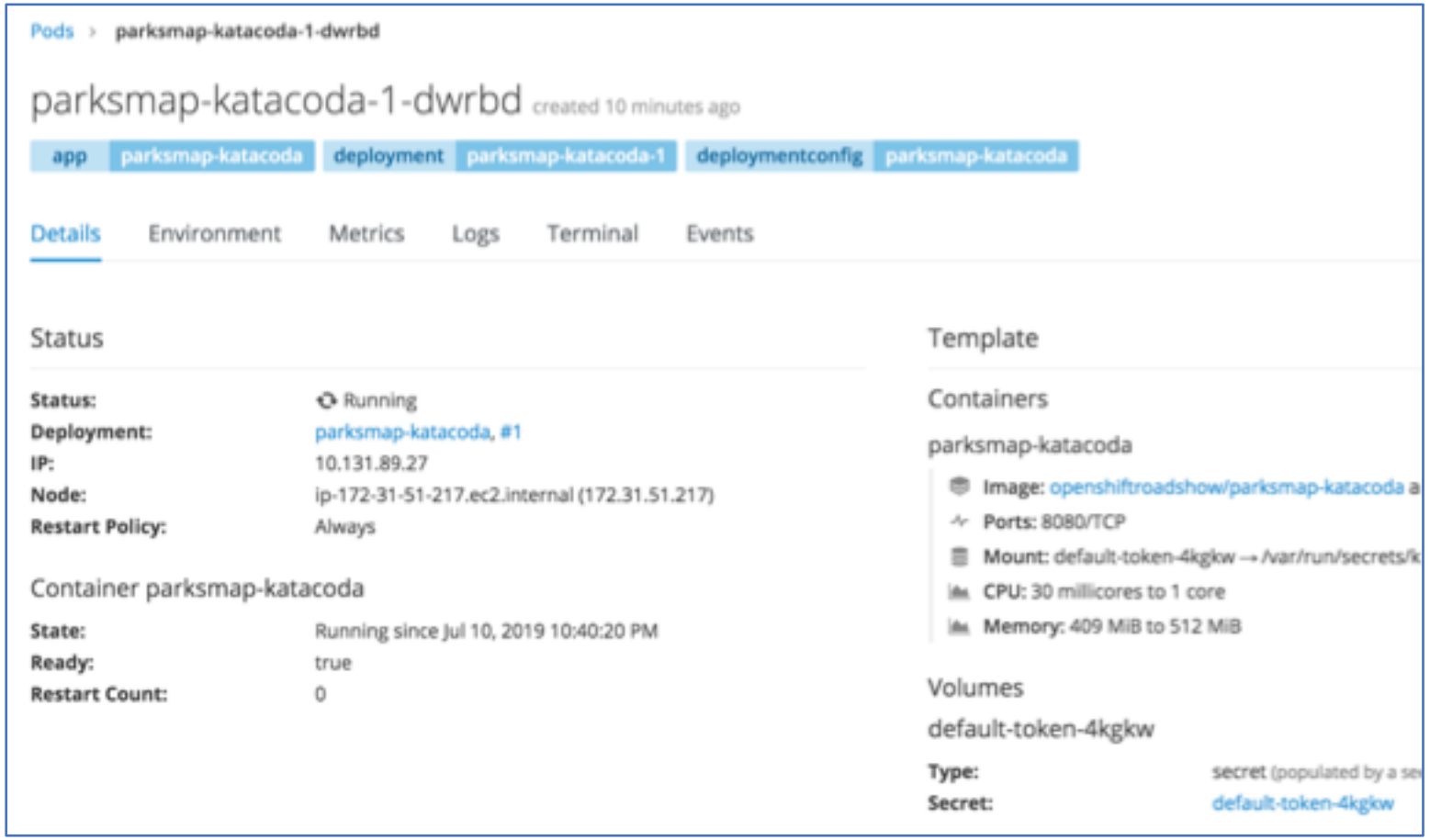


Ex 1: Deploy Application – Web Console (Using Image)

- Pods

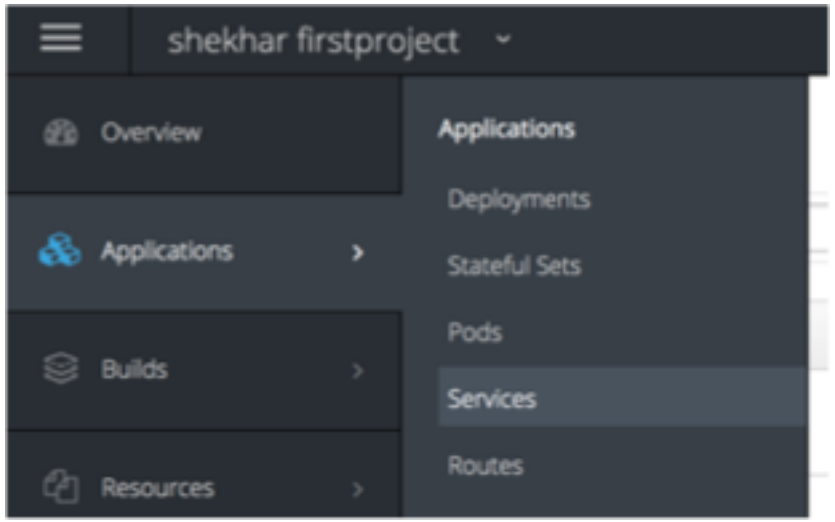


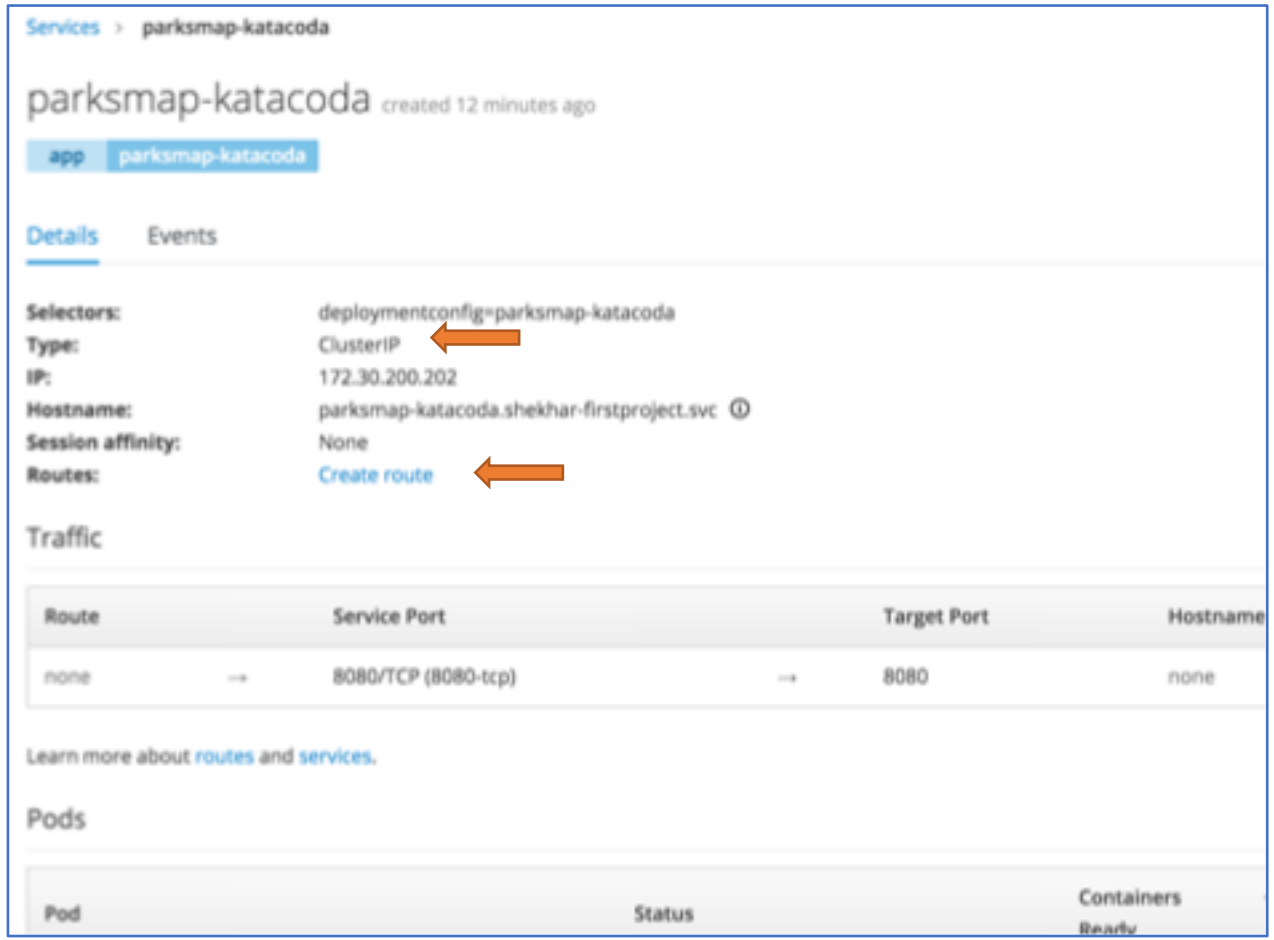




Ex 1: Deploy Application – Web Console (Using Image)

- Service

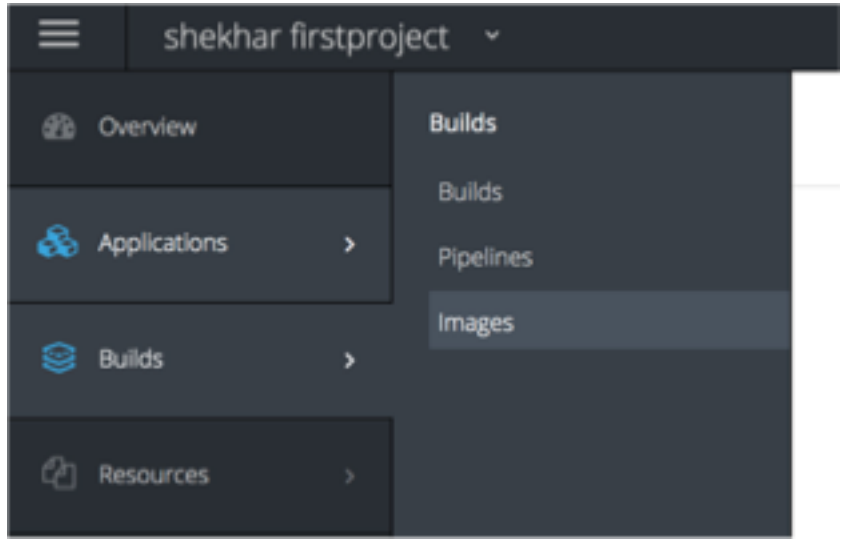


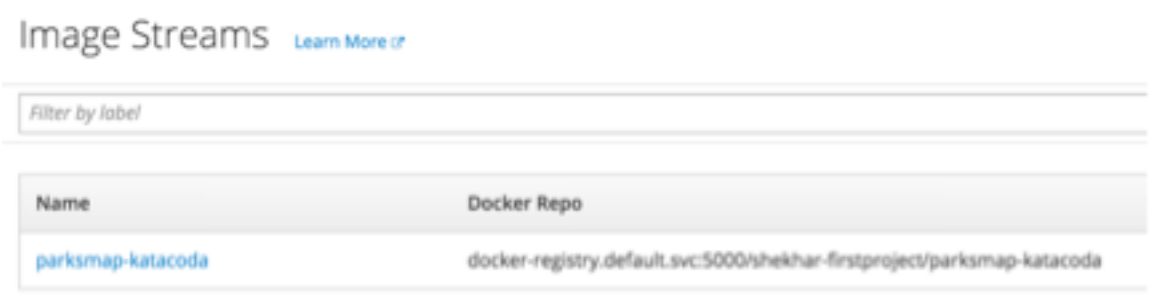


Note:- Check routes, there might be no routes

Ex 1: Deploy Application – Web Console (Using Image)

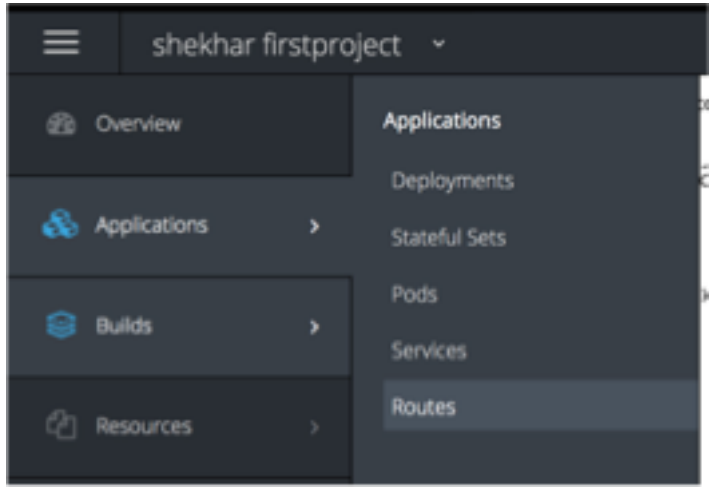
- Image Stream

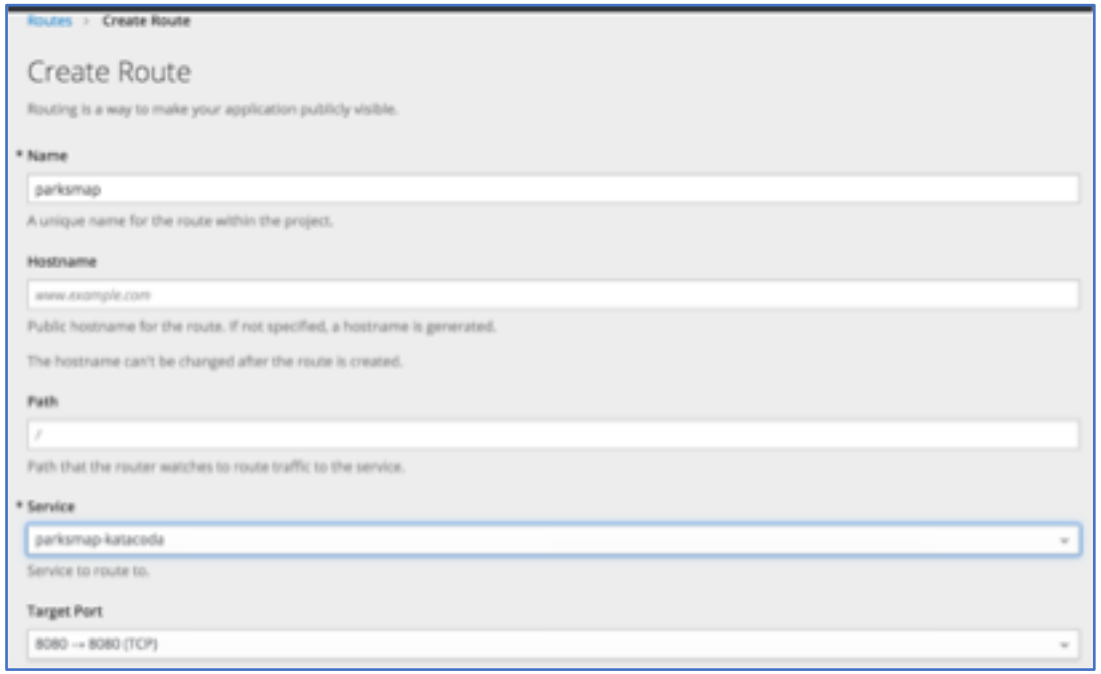


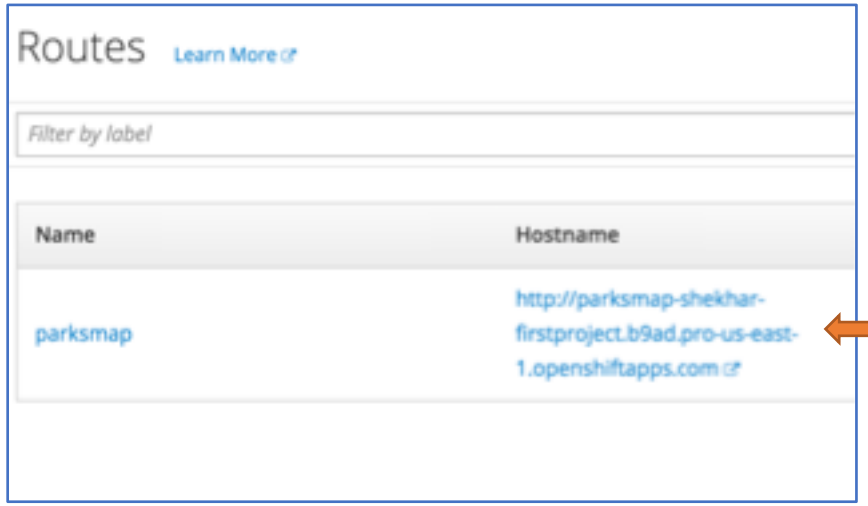


Ex 1: Deploy Application – Web Console (Using Image)

- Create Route



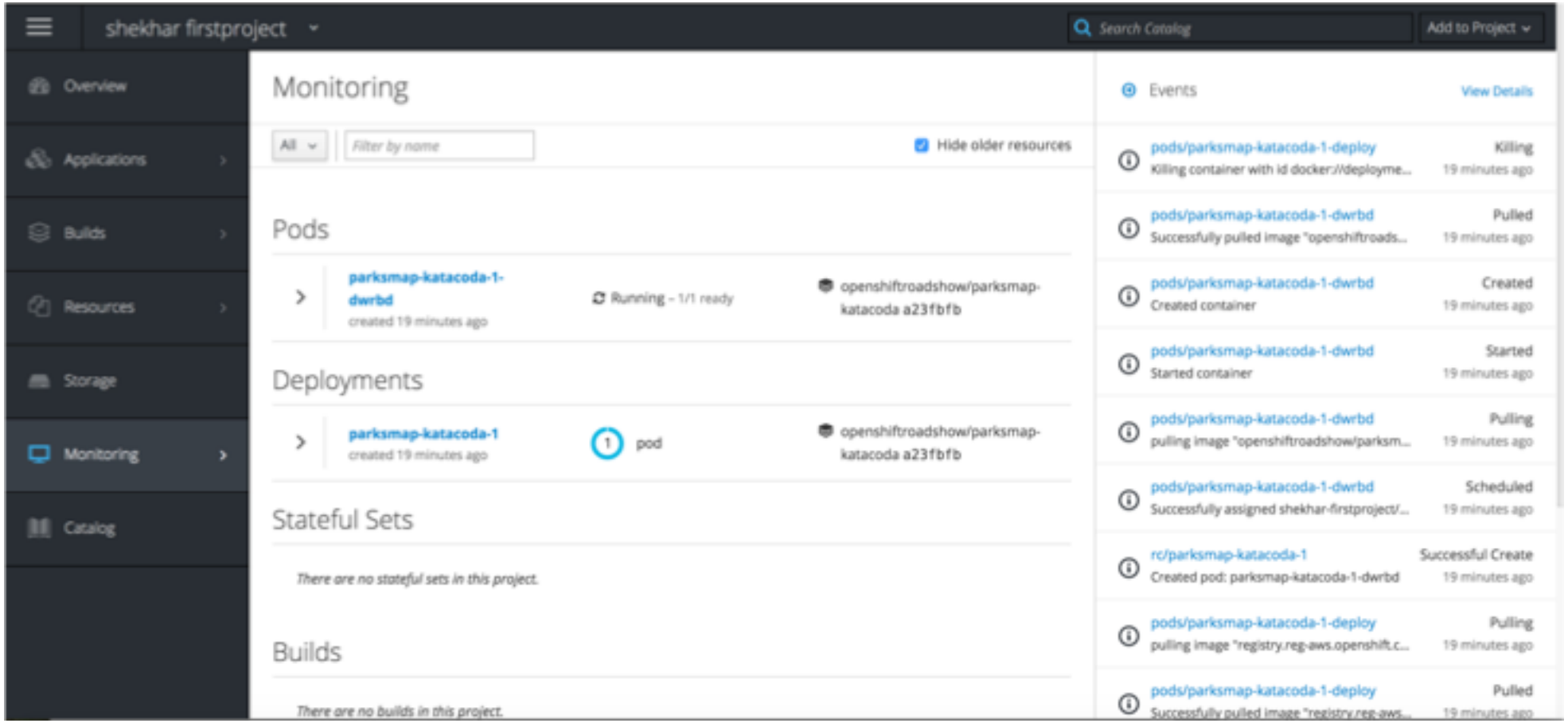




URL to access

Ex 1: Deploy Application – Web Console (Using Image)

- Monitoring and Events



Ex 2: Deploy Application – Web Console (Using S2I)

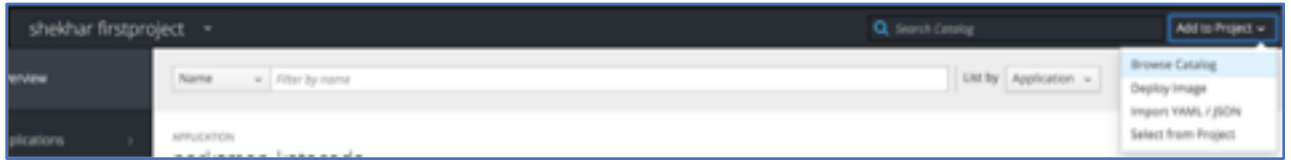
- Steps to execute

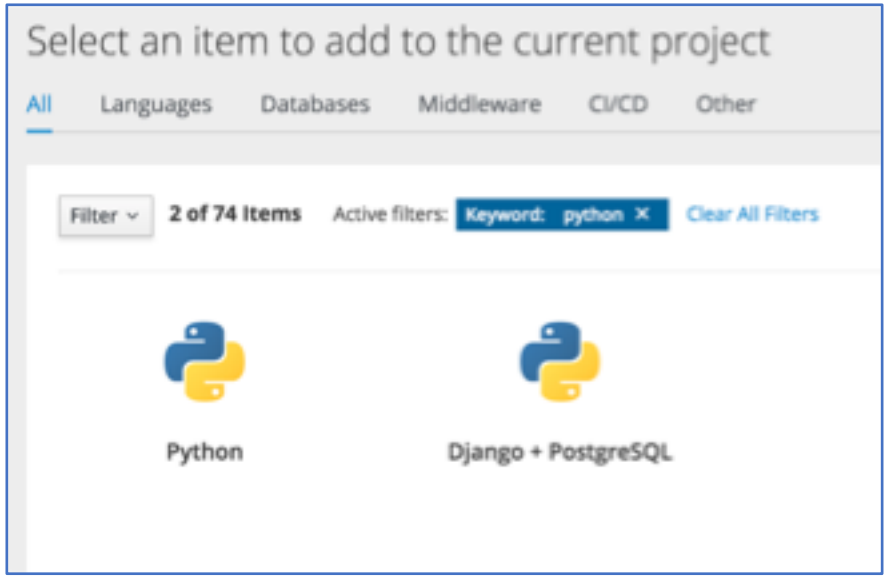
Steps:

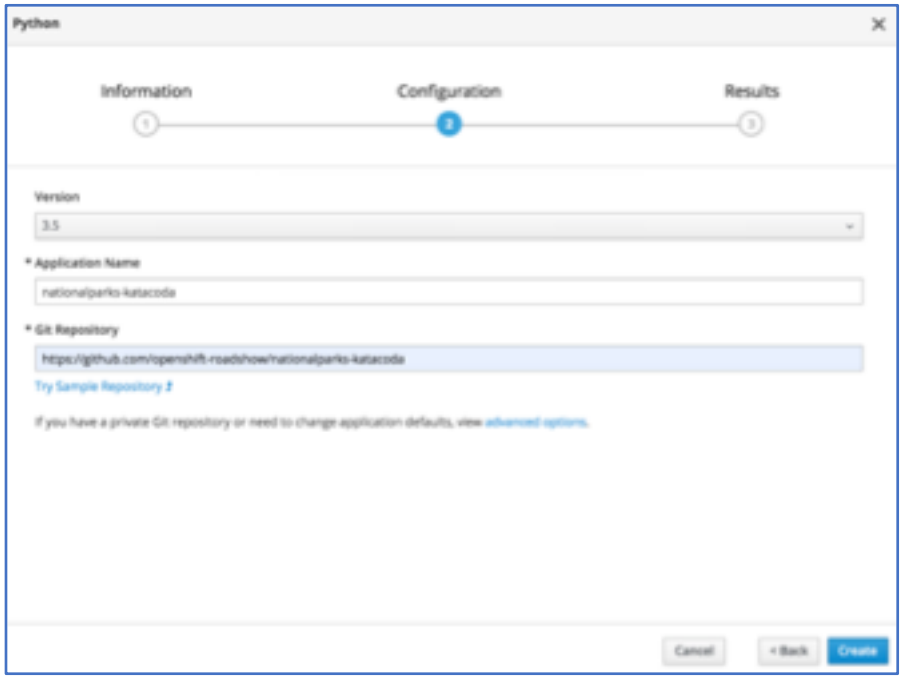
- Use the same project **<your-name>-firstproject**
- Add --> **browse catalog** --> select Python --> create application
- **Change Python version to 3.5** ; Provide name "**nationalparks-katacoda**"
- Provide Git repo "**https://github.com/openshift-roadshow/nationalparks-katacoda**"
- Scale up pod; Check logs; Check events
- Check Build; Check build config
- Check Image Stream
- Create route to expose external service

Ex 2: Deploy Application – Web Console (Using S2I)

- Steps in UI

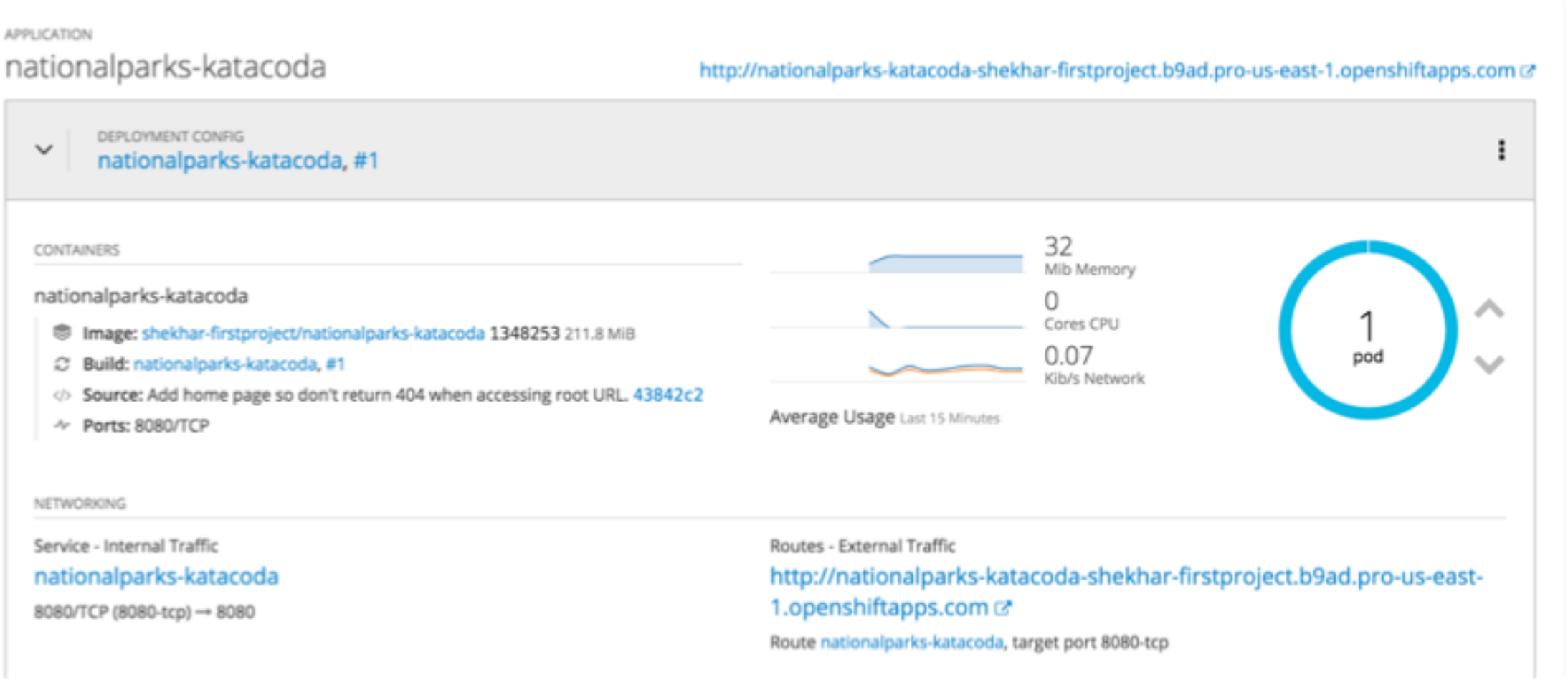






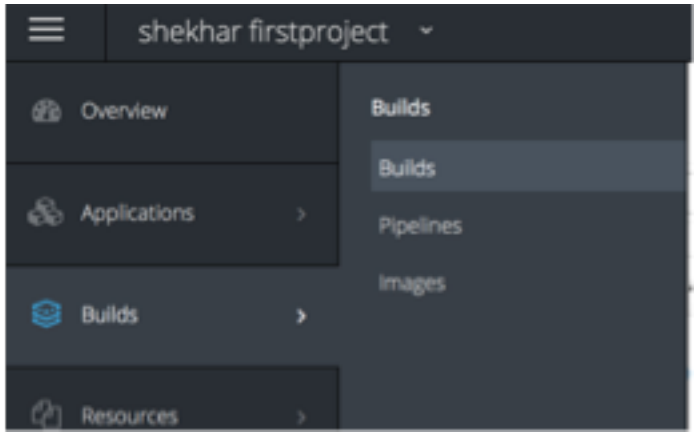
Ex 2: Deploy Application – Web Console (Using S2I)

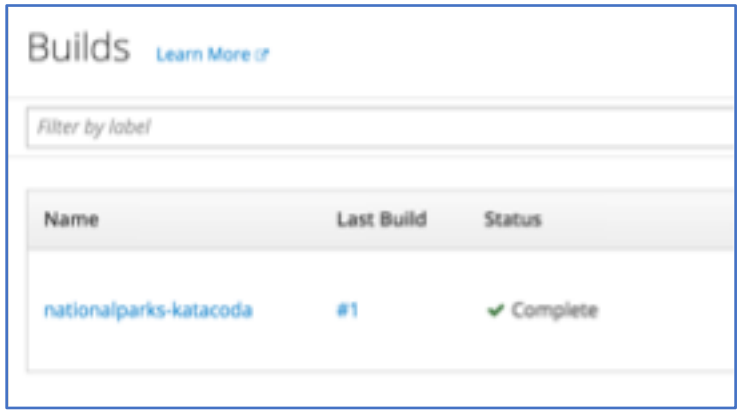
- Project overview

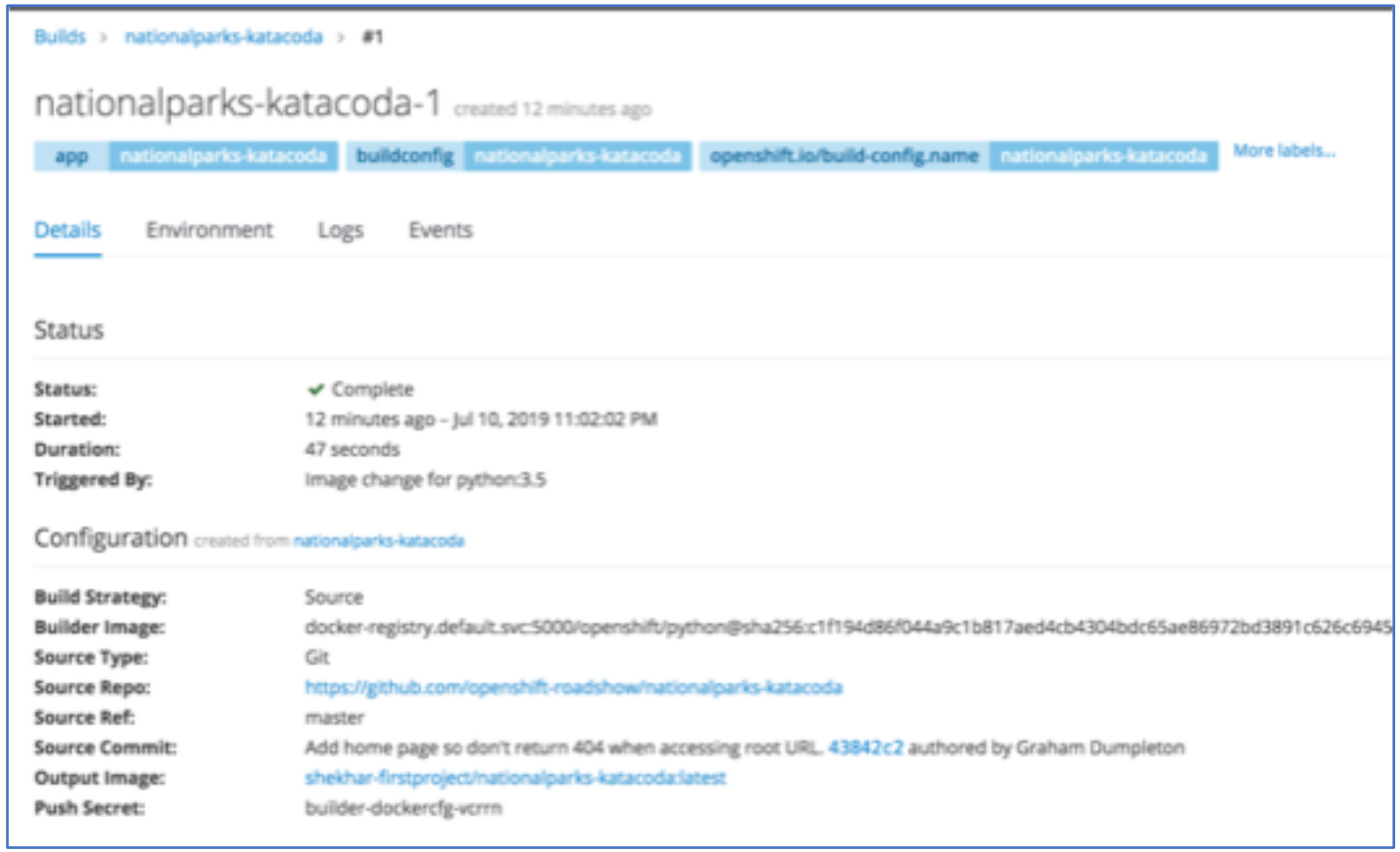


Ex 2: Deploy Application – Web Console (Using S2I)

- Build

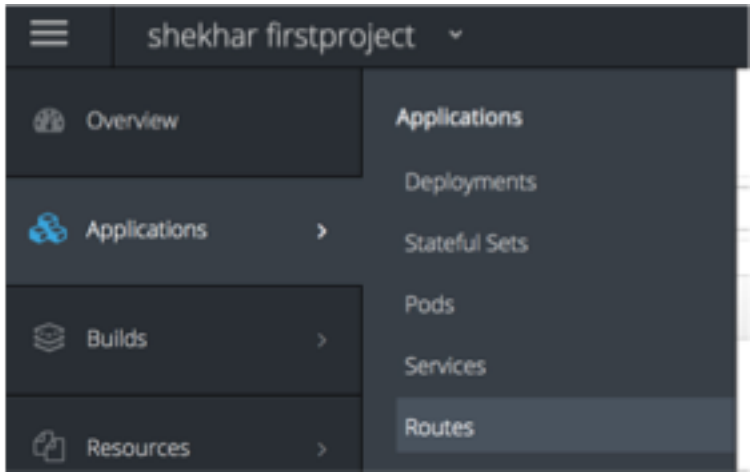




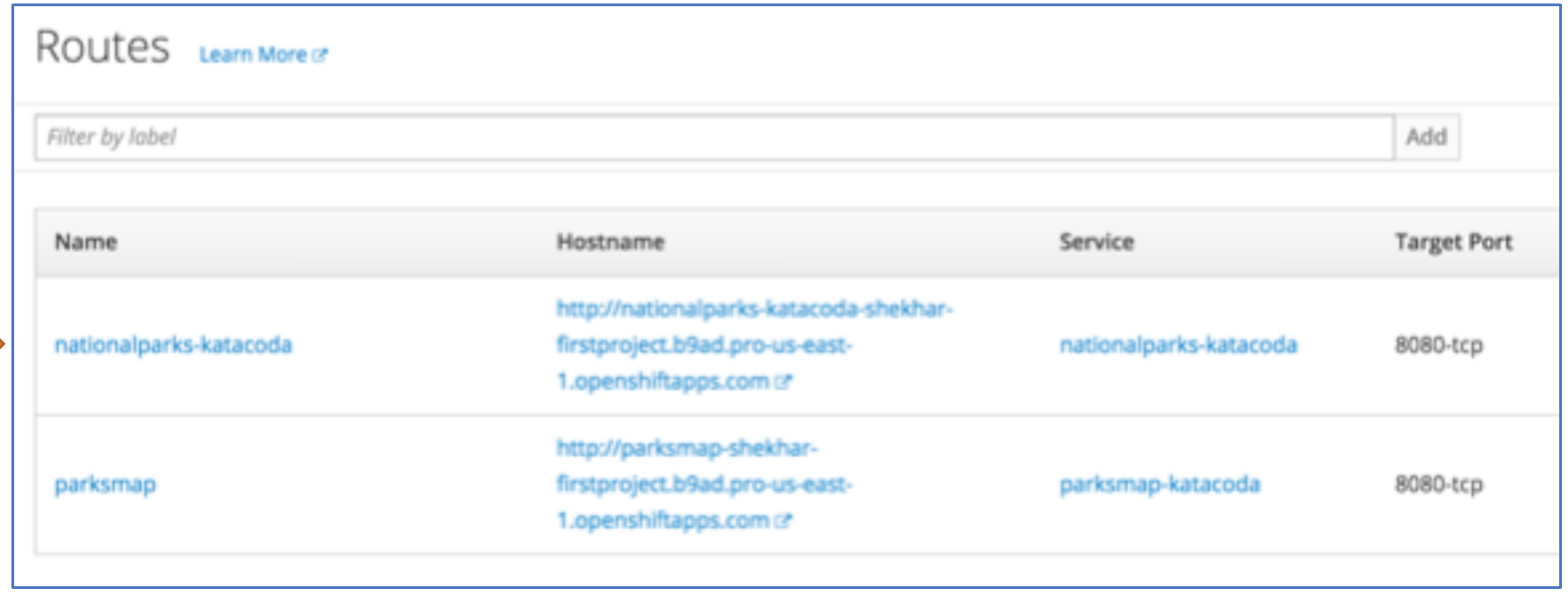


Ex 2: Deploy Application – Web Console (Using S2I)

- Route



Route auto created



Clean up

Delete the projects to save on limited resources

OpenShift – OC CLI labs

OpenShift OC Install

- **OC CLI:** Download the {command-line tool}, un-tar it and add to the {path}

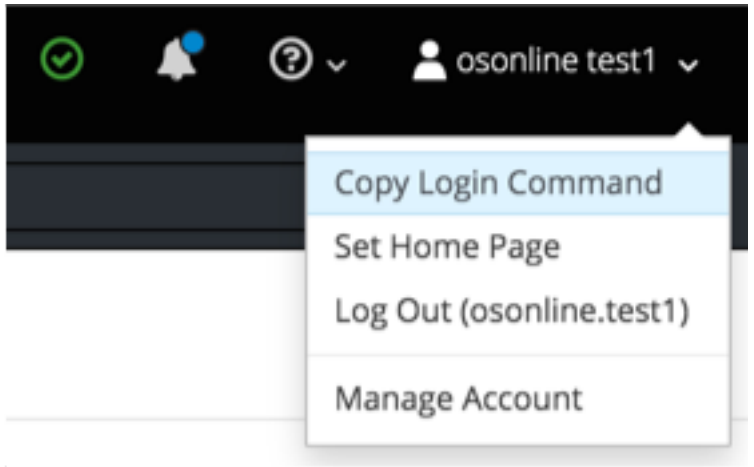
https://github.com/shekhar2010us/kubernetes_teach_git/blob/master/openshift/openshift_oc_cli_download.md

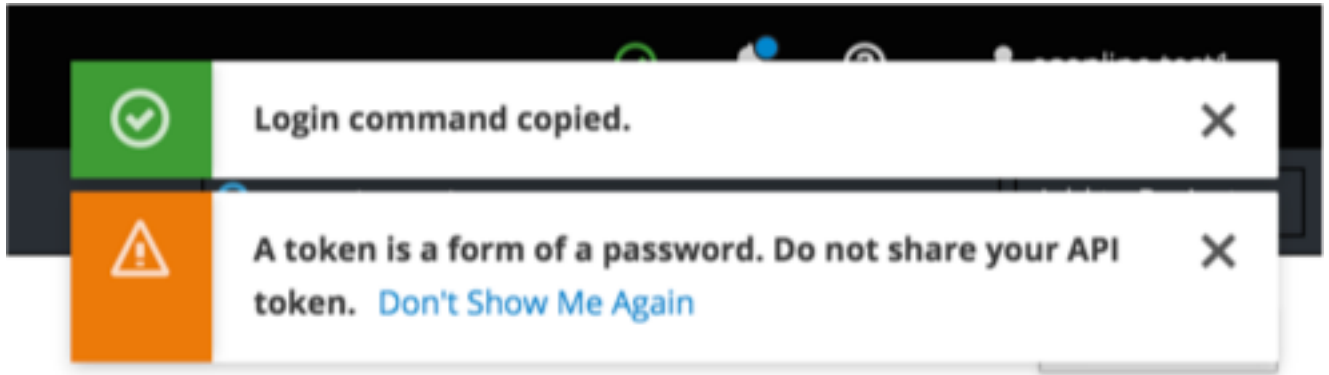
OpenShift OC Login

- **Login token:** In the top right corner, click “Copy Login Command”. This will bring the login token

Format: oc login <url> --token=<token>

- **CLI Login:** In a terminal, paste the above command to login to the OpenShift online Cluster





Ex 4: Deploy Application – CLI (Using S2I)

Steps:

- Create a new project **<your-name>-secondproject**
- Create an App using S2I --> using Wildfly 10.0
- Provide name "**openshift-helloworld**"
- Fork the git https://github.com/shekhar2010us/openshift-helloworld.git
- Provide Git repo "**<your forked repo>**"
- Scale up pod; Check logs; Check events
- Check Build; Check build config
- Check Image Stream
- Create route to expose external service

https://github.com/shekhar2010us/kubernetes_teach_git/blob/master/openshift/openshift_oc_ex4_s2i.md

Ex 5: Deployment using Webhook

Steps:

- Use the existing project <your-name>-secondproject
- Find the webhook URI for your particular application
- Add webhook in your git project
- Make changes, push to git, these changes will trigger a new build

https://github.com/shekhar2010us/kubernetes_teach_git/blob/master/openshift/openshift_oc_ex5_webhook.md

Clean up

Delete the projects to save on limited resources

Application Template

- Describes a **parameterized set of objects** to produce a list of objects for creation.
- The objects to create can include anything that users have permission to create.
- May also define a **set of labels** to apply to every object defined in the template.

<u>What a templates contains:</u>

- A set of resources, set of values and matching label

<u>Scope of templates:</u>

- Global or local to projects

Creating an Application Template

Important components

- **OpenShift Images**: Base images
  - S2I or Docker images with name and tag
  - ImageStream or private registries
- **Builds**: Generate an image from source code
  - BuildConfig – source; strategy (s2i, docker, custom); output description; list of triggers
- **Images**: Images produced by the builds, store it in ImageStream or private registry
- **Deployments**: This is the core, what images will be deployed and how
  - DeploymentConfig – images, replica, triggers to create deployment automatically, strategy, etc.
- **Abstractions**: Additional resources needed for our application, like networking, storage, security,…

Ex 6: Application Template

- The application template we will be using will create a full Java EE application and a MongoDB database that will perform geospatial queries to update a map via REST endpoints.

https://github.com/shekhar2010us/kubernetes_teach_git/blob/master/openshift/openshift_oc_ex6_templates.md

Create Templates from an existing Project

No filter – export all resources from the current project

```
oc export -o json --as-template=my_template > my_template.json
```

Limit resources

// export all services to a template

```
oc export -o json service --all --as-template=my_template > my_template.json
```

// export the services and deployment configurations labeled name=test

```
oc export -o json svc,dc -l name=test --as-template=my_template > my_template.json
```

Pointers when creating Templates

- Create templates on a **project/team basis**, this reduces lot of ongoing effort
- Provide meaningful names to resources and use **labels** to describe your resources. Be as verbose as possible, you can't add README
- **Parameterize everything** – a user might want to customize
- When the resources in a template are created, if there is a **BuildConfiguration** defined, it will only start an **automated build** if there is an **ImageChange** trigger defined. This will change in the next release and we will be able to launch a build on resource creation
- You should **constrain the CPU and memory** a container in a pod can use

Clean up

Delete the projects to save on limited resources

References

OpenShift CLI Reference:

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