Red Hat Container Development Kit 2.3
Getting Started Guide

Quick-start guide to using and developing with Red Hat Container Development Kit

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Abstract

This guide shows how to get up to speed using Red Hat Container Development Kit. Included instructions and examples guide through first steps developing containerized applications using Docker, Kubernetes, and OpenShift Container Platform, both from your host workstation (Microsoft Windows, macOS, or Red Hat Enterprise Linux) and from within the Container Development Environment provided by Red Hat Container Development Kit.

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CHAPTER 1. INTRODUCING RED HAT CONTAINER DEVELOPMENT KIT

Red Hat Container Development Kit is a platform for developing containerized applications — it is a set of tools that enables developers to quickly and easily set up an environment for developing and testing containerized applications on the Red Hat Enterprise Linux platform.

- Container Development Kit provides a personal Container Development Environment you can install on your own laptop, desktop, or server system. The Container Development Environment is provided in the form of a Red Hat Enterprise Linux virtual machine. The Container Development Environment itself can also be installed in a virtual machine.
- Container Development Kit includes the same container-development and run-time tools used to create and deploy containers for large data centers.
- Container Development Kit offers an easy installation method that results in virtual machines created from pre-configured Vagrant boxes and Vagrantfiles running on your local system.
- Container Development Kit is available for Microsoft Windows, Mac OS X, and Linux operating systems, thus allowing developers to use their favorite platform while producing applications ready to be deployed in the Red Hat Enterprise Linux ecosystem.

Container Development Kit is a part of the Red Hat Developers program, which provides tools, resources, and support for developers who wish to utilize Red Hat solutions and products to create applications, both locally and in the cloud. For additional information and to register to become a part of the program, visit developers.redhat.com.

1.1. UNDERSTANDING CONTAINER DEVELOPMENT KIT DOCUMENTATION

- The Red Hat Container Development Kit 2.3 Release Notes and Known Issues contains information about the current release of the product as well as a list of known problems that users may encounter when using it.
- The Red Hat Container Development Kit 2.3 Installation Guide guide contains instructions for installing the Container Development Environment provided by Red Hat Container Development Kit on your chosen system.
- The Container Development Kit Getting Started Guide contains instructions on how to start using the Container Development Environment to develop Red Hat Enterprise Linux-based containers using tools and services such as **OpenShift Container Platform**, **Docker**, **Eclipse**, and various command-line tools.
- Report issues with Red Hat Container Development Kit or request new features using the **CDK** project at https://issues.jboss.org/projects/CDK.

1.2. ABOUT CONTAINERS

Containers are a form of operating-system-level virtualization, which is based on sharing the underlying host system's kernel while providing multiple user-space instances (software containers). Containers are easier to build and initialize than hardware-level virtual machines, which makes them useful for situations where virtual environments need to be deployed rapidly or in large numbers. Applications running inside virtual software containers remain isolated from the host system.

1.3. ABOUT CONTAINER DEVELOPMENT KIT

Container Development Kit enables the development of containers on Red Hat Enterprise Linux, regardless of what operating system you use on your development workstation. The core of the development environment is a virtualized instance of Red Hat Enterprise Linux managed by Vagrant, an open-source tool for using light-weight, portable, and consistent development environments. Vagrant is utilized to bring up a pre-built Red Hat Enterprise Linux virtual machine with the Container Development Kit software components installed. Virtual machines that are packaged for use with Vagrant are called boxes.

Once you have the Container Development Kit software components installed, you can explore Linux container development using Docker, an open-source project that automates the deployment of applications inside of software containers. Docker is built upon a number of key Linux technologies that provide the capabilities to keep containers isolated and secure while controlling resource usage. For actual deployment and orchestration of containerized applications, Container Development Kit offers OpenShift with Kubernetes, a platform as a service (PaaS) product, which can be used to maintain underlying services and scale running applications as needed.

After the installation of Container Development Kit, the technology stack that is available to you for container development is:

Layer Description	Technology
Your Containers	Your application running in containers
Container management	Docker service
Development VM	Red Hat Enterprise Linux Server 7
VM management	Vagrant
Virtualization provider	Virtualbox, HyperV, or libvirt/KVM
Host machine OS	Microsoft Windows, macOS, or Red Hat Enterprise Linux 7

1.4. ABOUT VAGRANT

Vagrant has become a *de facto* standard for packaging and distributing development environments that run using most of the popular virtualization platforms on Windows, Mac OS X, and Linux as well as in the cloud with plugins for OpenStack, Amazon Web Services (AWS), and other environments.

Vagrant uses a single configuration file, the Vagrantfile, to describe a development environment. Using a Vagrantfile and a virtual-machine image packaged as a Vagrant box, a single command, **`vagrant up`**, brings up a consistent development environment that includes networking and

support for folders that are shared with the host OS for moving code, data, or configuration.

Container Development Kit includes a Vagrant box with a Red Hat Enterprise Linux system that is preconfigured to provide an environment for easy container development. The supplied Vagrant box can be deployed using VirtualBox, KVM (with libvirt), or HyperV as a virtualization platform. Container Development Kit also includes two Vagrantfiles that demonstrate Vagrant provisioning, which includes setting up private networking that exposes services from the virtual machine to the host system and other configuration tasks.

The **`vagrant ssh`** command is used to log into Vagrant boxes. The configuration details for networking and SSH keys are handled automatically by Vagrant.

1.4.1. Understanding Vagrant Configuration

Vagrant's power for creating and distributing portable and reproducible environments derives from using a single file (Vagrantfile) to describe the target environment. A Vagrantfile defines required resources, such as virtual-machine images, networking, and provisioning steps. A separate directory containing a Vagrantfile is used for each target environment.

1.4.1.1. Managing Vagrantfiles

Vagrant commands that take action on a specific environment need to either specify the ID of the environment (if it has already been initialized) or be executed in the directory that contains the environment's Vagrantfile. That directory forms a 'root' directory for the environment. Within this 'root' directory, Vagrant stores state information for the given environment in the **`.vagrant`** subdirectory.

Container Development Kit includes a number of sample Vagrantfiles in separate directories with a **`README`** file in each one. Start by changing into the directories, viewing the **`README`** and **`Vagrantfile`** files, and then starting the environment with the **`vagrant up`** command.

Note

The tilde character (**`~`**) used in a file-system path denotes a user's home directory on Unix-based operating systems, such as Mac OS X or Linux. Therefore, **`~/.vagrant.d`** on Linux or macOS corresponds to **`%USERPROFILE%\.vagrant.d`** on Windows systems.

In addition to the per-environment configuration and state directories, Vagrant uses the **`~/.vagrant.d`** directory to store data that applies to all Vagrant environments run by a given user. When a Vagrant box is added, or plugins are installed, they are added to **`~/.vagrant.d`**. That is, when you run the **`vagrant box add`** command, the box's Vagrantfile is installed in the per-user Vagrant directory, **`~/.vagrant.d/boxes/`**. Since this is stored in the user's home directory, each user is completely independent and not able to see Vagrant boxes or plugins installed by another user.

Note

Vagrant does not use a concept of system-wide configuration, so even if you run Vagrant as root (Administrator), it only makes changes in the root's home directory, and these changes are not visible to regular users.

Each Vagrant box that you download or build has its own Vagrantfile, which provides basic configuration for that box. When a Vagrant box is added, the included Vagrantfile is copied into the per-user **~/.vagrant.d** directory. The settings in the box's Vagrantfile can be overridden with the per-environment Vagrantfile.

Finally, there is per-user Vagrantfile in **~/.vagrant.d** for configuration that should be available to all of the user's Vagrant environments. This file is not created by default.

1.4.2. Vagrant Synchronized Folders

When a box is brought up, Vagrant automatically creates a Vagrant synchronized directory using the **vagrant-sshfs** plugin. This synchronized directory maps your home directory on the host into the Container Development Kit virtual machine.

For example, **/home/joe/** on the host is synchronized to **/home/joe/**. On Microsoft Windows, the home folder, **C:\Users\joe** is mapped to **/c/home/joe** within the virtual machine.

This provides a convenient and automated method to move code, data, and configuration from the host machine to your Vagrant boxes.

A number of other methods are available for sharing folders or making copies, such as **rsync**, NFS, or VirtualBox shared folders. The type of synchronization used for each shared folder can be set in the definition for the shared folder in the Vagrantfile (the **config.vm.synced_folder** option). Shared folder definitions may also be in the Vagrantfile that comes with a Vagrant box. This is important to remember if you are trying to completely disable shared folders or change the method used for sharing data.

CHAPTER 2. INSTALLING RED HAT CONTAINER DEVELOPMENT KIT

Installation steps for setting up Container Development Kit on your development workstation (Microsoft Windows, macOS, Red Hat Enterprise Linux) are described in detail in the Red Hat Container Development Kit 2.3 Installation Guide. This section only provides a concise outline of the installation procedure for reference purposes.

Regardless of the host operating system you use, the installation of Container Development Kit always involves the following steps:

1. Installing or enabling a virtualization provider (VirtualBox on Microsoft Windows and macOS, libvirt and KVM on Red Hat Enterprise Linux).
2. Installing Vagrant.
3. Downloading Container Development Kit Vagrant box for your virtualization provider.
4. Downloading and unpacking Red Hat Container Tools.
5. Installing additional auxiliary tools, such as **`rsync`** (in case of Microsoft Windows).
6. Initializing the obtained Vagrant box.

CHAPTER 3. INTERACTING WITH RUNNING VAGRANT BOXES

To use a Vagrant box that is up and running, first change to the directory from which you started that box. For example, on Microsoft Windows, run:

```
C:\> cd %USERPROFILE%\cdk\components\rhel\rhel-ose
```

On Linux or macOS, run:

```
$ cd ~/cdk/components/rhel/rhel-ose
```

From that location, you can run different **`vagrant`** commands to use or manage the box in different ways.

List the subcommands available to use with your **`vagrant`** command:

```
$ vagrant list-commands
```

Log into your Container Development Kit Vagrant box using SSH. This automatically logs you into the Red Hat Enterprise Linux virtual machine as the **vagrant** user:

```
$ vagrant ssh
```

To exit the SSH session without affecting the Vagrant box, type **`exit`** in the virtual machine.

To stop the Vagrant box from the system, execute:

```
$ vagrant halt
```

To delete the created VM and free virtualization resources, use the **`vagrant destroy`** command. Your Vagrantfile and the box image in the **`.vagrant.d`** directory in your home directory will remain, allowing you to recreate a fresh version of the environment with a subsequent **`vagrant up`** command.

```
$ vagrant destroy
```

Note

Do not delete the **`.vagrant`** subdirectory where Vagrant keeps its per-machine state without first using the **`vagrant destroy`** command to free virtualization (libvirt or Virtualbox) resources.

If you no longer have the **`.vagrant`** subdirectory on a system using libvirt, you will need to use libvirt tools, such as **`virt-manager`** (GUI) or **`virsh`** (CLI), to manually delete the resources that were created by Vagrant before you can again start a Vagrant box with the same name. On a system using Virtualbox for virtualization, use the Virtualbox GUI to delete the resources you created with Vagrant.

After **`vagrant destroy`**, you will be able to bring the Vagrant box up again in its original, clean state.

To view the status of all Vagrant boxes on your system and verify that your box was properly stopped, use:

```
$ vagrant global-status
```

CHAPTER 4. USING VAGRANT CONTAINER DEVELOPMENT KIT PLUGINS

Container Development Kit comes with several plugins that provide added features you can use with your Vagrant boxes. This chapter contains descriptions of those plugins and ways to use them.

4.1. USING THE VAGRANT-SERVICE-MANAGER PLUGIN

On the host machine, you can use the **`vagrant-service-manager`** plugin to obtain information about the Docker, OpenShift, and Kubernetes services running in the virtual machine. It displays environment variables that need to be set on the host system (your development workstation) to enable host-based tools (such as the Eclipse IDE, the **`docker`** command, or OpenShift's **oc** command) to interact with the Docker daemon from the virtual machine.

The **`vagrant-service-manager`** plugin automatically recognizes the host operationg system and outputs information based on the platform.

4.1.1. Setting the Host Environment on Linux and macOS

Run the following command from the directory in which the Vagrant box was initialized (in this example, the **rhel-ose** Vagrantfile was used to provision the Container Development Kit Vagrant box):

```
~/cdk/components/rhel/rhel-ose]$ vagrant service-manager env
Configured services:
docker - running
openshift - running
kubernetes - stopped

docker env:
# Set the following environment variables to enable access to the
# docker daemon running inside of the vagrant virtual machine:
export DOCKER_HOST=tcp://10.1.2.2:2376
export DOCKER_CERT_PATH=/home/john/down/cdk/components/rhel/rhel-
ose/.vagrant/machines/default/libvirt/docker
export DOCKER_TLS_VERIFY=1
export DOCKER_API_VERSION=1.22
# run following command to configure your shell:
# eval "$(vagrant service-manager env docker)"

openshift env:
You can access the OpenShift console on: https://10.1.2.2:8443/console
To use OpenShift CLI, run: oc login https://10.1.2.2:8443
```

Run the following command to set the required environment variables, so that the **`docker`** client on the host system can be used to interact with the Docker service running inside the Container Development Kit virtual machine:

```
~]$ eval "$(vagrant service-manager env docker)"
```

4.1.2. Setting Up the Host Environment on Microsoft Windows

Run the following command from the directory in which the Vagrant box was initialized (in this example, the **rhel-ose** Vagrantfile was used to provision the Container Development Kit Vagrant box).

```
~/cdk/components/rhel/rhel-ose]$ vagrant service-manager env docker
# Set the following environment variables to enable access to the
# docker daemon running inside of the vagrant virtual machine:
export DOCKER_HOST=tcp://10.1.2.5:2376
export DOCKER_CERT_PATH='C:\cygwin64\home\cdk\cdk\components\rhel\rhel-
ose\.vagrant\machines\default\virtualbox\docker\'
export DOCKER_TLS_VERIFY=1
export DOCKER_API_VERSION=1.22
# run following command to configure your shell:
# eval "$(VAGRANT_NO_COLOR=1 vagrant service-manager env docker | tr -d
'\r')"

openshift env:
You can access the OpenShift console on: https://10.1.2.2:8443/console
To use OpenShift CLI, run: oc login https://10.1.2.2:8443
```

To set the required environment variables, so that the **`docker.exe`** client on the host system can be used to interact with the Docker service running inside the Container Development Kit virtual machine, you need to run the following commands (note that you need to use the Cygwin Bash environment for the commands to work properly):

```
~]$ export VAGRANT_DETECTED_OS=cygwin

~]$ eval "$(VAGRANT_NO_COLOR=1 vagrant service-manager env docker | tr
-d '\r')"
```

4.2. USING THE VAGRANT-REGISTRATION PLUGIN

With the **`vagrant-registration`** plugin, you can manage Red Hat subscriptions for your Red Hat Enterprise Linux virtual machines through Vagrant.

4.2.1. Understanding Red Hat Enterprise Linux Subscription for Container Development Kit

Registering your Red Hat Enterprise Linux system is highly recommended. Until you register, you cannot use the official Red Hat repositories to:

- Upgrade the software in your Red Hat Enterprise Linux virtual machine.
- Add more software packages to your Red Hat Enterprise Linux virtual machine.
- Add software packages to the Red Hat Enterprise Linux containers you build or run on that virtual machine.

Red Hat Enterprise Linux base container images are configured to have Docker use the credentials of the host system. So when you try to install packages inside of a container, the **`yum`** command uses the host credentials to gain access to those packages from Red Hat. Without a valid Red Hat subscription, you will not have a fully functioning setup for building Red Hat Enterprise Linux containers.

The process of registering your Container Development Kit virtual machine with Red Hat is

automated using the **vagrant-registration** plugin. By default, when a Vagrant box is started, you are prompted to enter your username and password for the Red Hat Customer Portal. When the registration plugin is properly configured, the Vagrant box is automatically attached to an available subscription.

When a Red Hat Enterprise Linux VM is registered in Container Development Kit, an identity and time-limited entitlement is created for that VM. Once it is registered, the VM does not need to be re-registered until the Container Development Kit entitlement expires. Once the time limit is up, that container loses access to the Red Hat software repositories (CDN).

You can register your Container Development Kit system with a valid Red Hat Enterprise Linux Developer Subscription. Joining the Red Hat Developers program also provides a path to getting registration credentials. Once you register a Container Development Kit VM, you get a new entitlement that lasts for 90 days that does not come out of your pool. If you re-register the same VM, you will get a new 90 day entitlement. You can do this over and over.

4.2.2. Releasing a Subscription

There are a few things you should know about releasing a subscription:

- When you stop the Vagrant box, using either **vagrant halt** or **vagrant destroy**, the plugin automatically releases the Red Hat subscription.
- If you stop the box by some other means, such as a reboot of the host system, you may need to manually remove the subscription in order to use it on another box. Use subscription management at Red Hat Customer Portal Subscriptions to find and delete the virtual system that is no longer being used.
- If you do not want to unregister a system when it is halted, you can set **config.registration.unregister_on_halt = false** in the selected Vagrantfile. In that case, the subscription will still be intact the next time you run **vagrant up** on that Vagrantfile.

4.2.3. Automating the Registration Process (Saving Your Credentials)

It is recommended that you store your Red Hat credentials, so that you do not have to answer the prompts every time you bring up a Vagrant box. This is mandatory for complex Vagrantfiles that bring up multiple virtual machines from a single Vagrantfile.

To store your credentials, the following lines should be added to the per-user Vagrantfile. The path to that file is different for the different platforms:

- Microsoft Windows: **%USERPROFILE%\.vagrant.d\Vagrantfile**
- Red Hat Enterprise Linux and macOS: **~/.vagrant.d/Vagrantfile**

The configuration will be available to all boxes started under that user ID. The per-user Vagrantfile is not created automatically.

```
Vagrant.configure('2') do |config|
 config.registration.username = '<your Red Hat username>'
 config.registration.password = '<your Red Hat password>'
end
```

To avoid storing your Red Hat credential details in the file system, you can use the following configuration to retrieve them from environment variables. Remember to store your username in the **$SUB_USERNAME** environment variable (**SUB_USERNAME** for Microsoft Windows) and your

password in the **$SUB_PASSWORD** environment variable (**SUB_PASSWORD** for Microsoft Windows) before starting Vagrant.

```
Vagrant.configure('2') do |config|
  config.registration.username = ENV['SUB_USERNAME']
  config.registration.password = ENV['SUB_PASSWORD']
end
```

These settings may also be used in a specific Vagrantfile that will override the settings in the per-user **~/.vagrant.d/Vagrantfile**. In an existing Vagrantfile, there will already be a block that begins with **Vagrant.configure('2') do |config|**, so just add the two **config.registration** lines (see above) in the existing block.

For more information, see the **vagrant-registration-README.md** file in the **~/cdk/plugins** directory of the Red Hat Container Tools ZIP file.

4.2.4. Additional Resources

- For more information on configuring the **vagrant-registration** plugin, see the vagrant-registration GitHub page.
- For information about subscription management, see the documentation for Red Hat Subscription Management.

CHAPTER 5. USING CONTAINER DEVELOPMENT KIT WITH DOCKER TOOLING IN ECLIPSE

You can access the Docker service runnning on the CDK Red Hat Enterprise Linux VM from an Eclipse IDE running on your local system.

1. Install Eclipse on the system where you are running Container Development Kit and start Eclipse. For example, to install and start Eclipse on Red Hat Enterprise Linux, do the following:

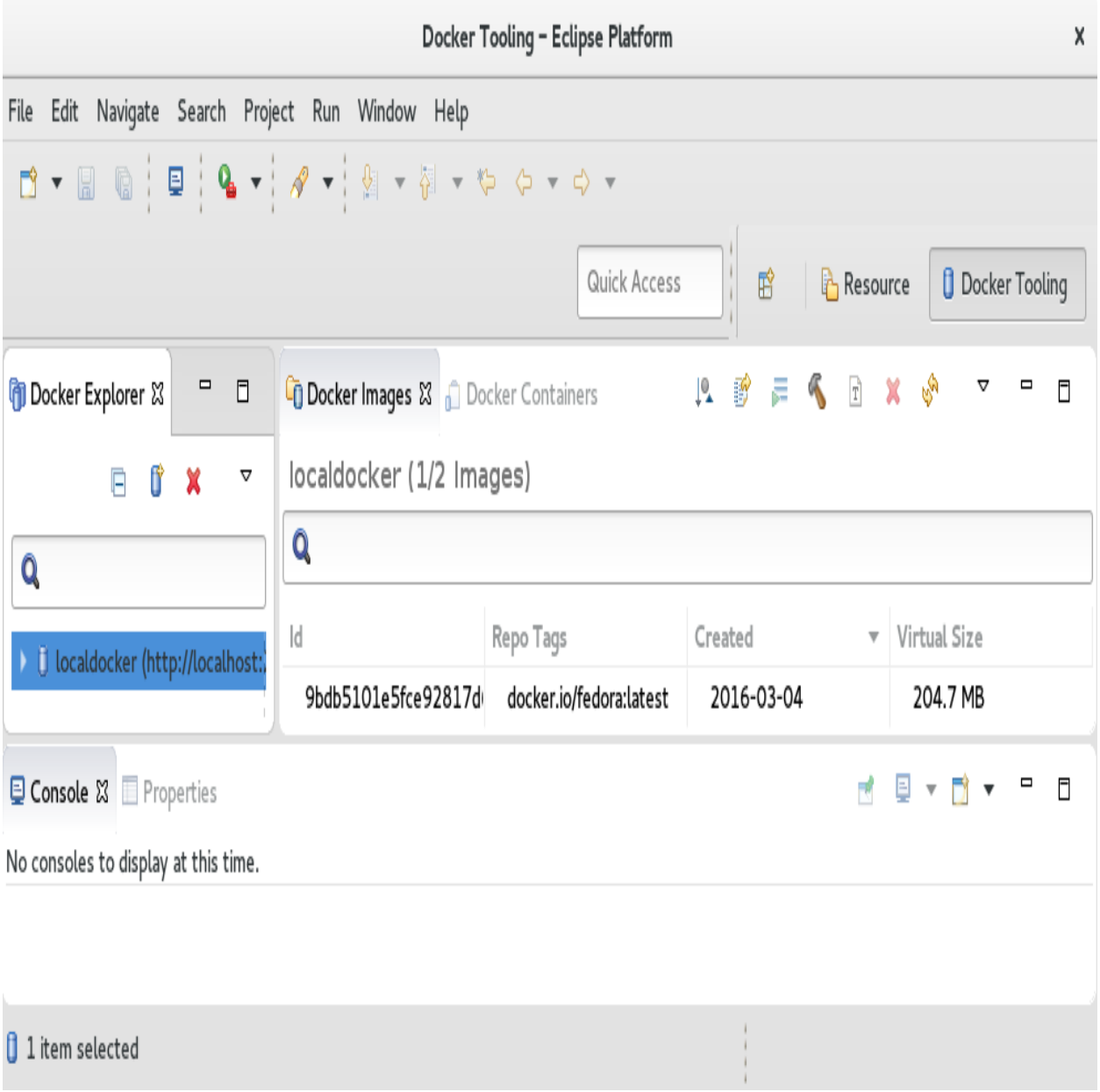
```
# yum install devtoolset-4-eclipse devtoolset-4-eclipse-
linuxtools \
  devtoolset-4-eclipse-linuxtools-docker.noarch
```

2. Enable the Eclipse software collection from Red Hat Developer Toolset:

```
$ cd ~/cdk/components/rhel/rhel-ose/
$ eval "$(vagrant service-manager env docker)"
$ scl enable devtoolset-4 'eclipse' &
```

3. Select a workspace. Choose a directory to store our Eclipse work on your local desktop (such as **`/home/joe/workspace`**). The Eclipse Platform screen appears.

4. Open the **Docker** perspective. Select **Window** → **Perspective** → **Open Perspective** → **Other** → **Docker Tooling** → **OK**. Then select the **Workbench** icon. The **Docker Tooling - Eclipse Platform** screen should appear as shown in Figure 5-2



You can now begin using the **Eclipse Docker Tooling** screen to work with Docker-formatted container images from inside the Container Development Kit virtual machine.

CHAPTER 6. USING THE DOCKER SERVICE

When you initialize the Container Development Kit virtual machine (using the **`vagrant up`** command), various services are automatically pre-configured and running — depending on the Vagrantfile you used to provision the Container Development Kit box. The Docker service is running in all cases, and you can use it immediately after the virtual machine is launched. While it is possible to use and interact with the Docker service using GUI tools (for example, the integrated Docker support provided by the Eclipse IDE), this section introduces a number of basic **`docker`** commands to get you started using the Docker service from the command line.

Command-line usage of the Docker service provided by the Container Development Kit box is possible both from within the virtual machine and from the host machine — see section Using the vagrant-service-manager Plugin for instructions on how to set up your host machine to interact with the Docker service running inside the Container Development Kit virtual machine.

See the Get Started with Docker Formatted Container Images chapter of the *Red Hat Enterprise Linux Atomic Host 7 Getting Started with Containers* guide for a more thorough introduction into the Docker service.

6.1. PREPARING HOST SYSTEM FOR USING DOCKER FROM THE COMMAND LINE

To use the **`docker`** command on your host system to interact with the Docker service running inside the Container Development Kit virtual machine, you need to install the **`docker`** executable.

If you intend to use Docker (and the **`docker`** command) only from within the Container Development Kit virtual machine, no preparation is required — the **`docker`** command is installed in the Container Development Kit box by default.

6.1.1. Installing the `docker` Executable

Use the **`install-cli`** command of the **`vagrant-service-manager`** plugin to install the **`docker`** binary on your host system.

For example:

```
~]$ vagrant service-manager install-cli docker
# Binary now available at /home/joe/.vagrant.d/data/service-
manager/bin/docker/1.10.3/docker
# run binary as:
# docker <command>
export PATH=/home/joe/.vagrant.d/data/service-
manager/bin/docker/1.10.3:$PATH

# run following command to configure your shell:
# eval "$(VAGRANT_NO_COLOR=1 vagrant service-manager install-cli docker
| tr -d '\r')"
```

Note

To use the **`install-cli`** command when behind a proxy, the Container Development Environment needs to be configured to operate behind a proxy using the **`vagrant-service-manager`** plugin. See section Using vagrant-service-manager to Set Proxy Environment Variables in the Red Hat Container Development Kit 2.3 Installation Guide.

6.1.1.1. Installing a Custom Version of the `docker` Binary

By default, the **`install-cli`** command installs the **`docker`** binary from the upstream Docker project in version 1.10.3. To install a different version, use the **`--cli-version`** option.

For example:

```
~]$ vagrant service-manager install-cli docker --cli-version 1.12.3
# Binary now available at /home/joe/.vagrant.d/data/service-
manager/bin/docker/1.12.3/docker
# run binary as:
# docker <command>
export PATH=/home/joe/.vagrant.d/data/service-
manager/bin/docker/1.12.3:$PATH

# run following command to configure your shell:
# eval "$(VAGRANT_NO_COLOR=1 vagrant service-manager install-cli docker
--cli-version 1.12.3 | tr -d '\r')"
```

6.1.1.2. Installing the `docker` Binary to a Custom Location

By default, the **`install-cli`** command installs the **`docker`** binary from the upstream Docker project to the following directory: **`/home/joe/.vagrant.d/data/service-manager/bin/docker/1.10.3/`**. To install the executable to a different location, use the **`--path`** option. Note that you need to specify an existing directory and the name of the binary.

For example:

```
~]$ vagrant service-manager install-cli docker --cli-version 1.12.3 --
path ~/bin/docker
# Binary now available at /home/joe/bin/docker
# run binary as:
# docker <command>
export PATH=/home/joe/bin:$PATH

# run following command to configure your shell:
# eval "$(VAGRANT_NO_COLOR=1 vagrant service-manager install-cli docker
--path /home/joe/bin/docker --cli-version 1.12.3 | tr -d '\r')"
```

6.2. LEARNING ABOUT THE DOCKER ENVIRONMENT

The **`docker`** command offers several sub-commands that let you acquire information about the Docker service, the environment it runs in, and available resources. You can also query the service for images and containers it manages and for images that are available to you from the pre-

configured registries. By default, the Docker service in Container Development Kit can download and use images from both the Docker Hub (*docker.io*) and the Red Hat Atomic Registry (*registry.access.redhat.com*).

Use the following commands to obtain information about the Docker service and the working environment.

6.2.1. Verifying the Version of the Docker Service

Run the **`docker version`** command to see the version of both the Docker Client and Docker Server:

```
~]$ docker version
Client:
 Version:         1.10.3
 API version:     1.22
 Package version: docker-1.10.3-46.el7.14.x86_64
 Go version:      go1.4.2
 Git commit:      78ee77d/1.10.3
 Built:
 OS/Arch:         linux/amd64

Server:
 Version:         1.10.3
 API version:     1.22
 Package version: docker-1.10.3-46.el7.14.x86_64
 Go version:      go1.4.2
 Git commit:      78ee77d/1.10.3
 Built:
 OS/Arch:         linux/amd64
```

6.2.2. Displaying Information about the System and Resources

Run the **`docker info`** command to see information about the host system (which, in this case, is the virtualized Red Hat Enterprise Linux instance managed by Vagrant), utilization of virtualization resources, basic networking information, and the numbers of managed containerrs and images:

```
~]$ docker info
Containers: 14
Images: 32
Server Version: 1.9.1
Storage Driver: devicemapper
 Pool Name: VolGroup00-docker--pool
 Pool Blocksize: 524.3 kB
 Base Device Size: 107.4 GB
 Backing Filesystem: xfs
 Data file:
 Metadata file:
 Data Space Used: 2.172 GB
 Data Space Total: 13.6 GB
 Data Space Available: 11.43 GB
 Metadata Space Used: 1.016 MB
 Metadata Space Total: 46.14 MB
 Metadata Space Available: 45.12 MB
 Udev Sync Supported: true
```

```
 Deferred Removal Enabled: true
 Deferred Deletion Enabled: true
 Deferred Deleted Device Count: 0
 Library Version: 1.02.107-RHEL7 (2015-12-01)
Execution Driver: native-0.2
Logging Driver: json-file
Kernel Version: 3.10.0-514.el7.x86_64
Operating System: Red Hat Enterprise Linux Server 7.3 (Maipo)
CPUs: 2
Total Memory: 2.781 GiB
Name: rhel-cdk
ID: PZ3X:6J7V:OF4L:KZRY:XXDT:QXCU:UHGQ:XMWE:EMM5:4POR:CG6D:YF4S
```

6.3. LEARNING ABOUT CONTAINERS AND IMAGES

Use the following commands to obtain information about images and containers on your system.

6.3.1. Listing Managed Images

Run the **`docker images`** command to display a list of images available in the local registry.

```
~]$ docker images
REPOSITORY                                                TAG
IMAGE ID      CREATED      VIRTUAL SIZE
docker.io/prom/haproxy-exporter                           latest
2b168f203700  11 days ago  23.64 MB
registry.access.redhat.com/openshift3/ose-pod             v3.1.1.6
2b96d2bcbc46  2 weeks ago  428 MB
registry.access.redhat.com/openshift3/ose-sti-builder     v3.1.1.6
983aa720a8e7  3 weeks ago  441.9 MB
registry.access.redhat.com/openshift3/ose-deployer        v3.1.1.6
d772a87d1aac  3 weeks ago  441.9 MB
registry.access.redhat.com/openshift3/ose                 v3.1.1.6
88178069a37f  3 weeks ago  441.9 MB
registry.access.redhat.com/openshift3/ose-haproxy-router  v3.1.1.6
5e18f7fbcc6c  3 weeks ago  456.8 MB
registry.access.redhat.com/openshift3/ose-docker-registry v3.1.1.6
3c272743b20a  3 weeks ago  478.5 MB
```

6.3.2. Listing Managed Containers

Run the **`docker ps`** command to display a list of running containers. Add the **`--all`** or **`-a`** parameter to list all available containers (not just the running ones). As you can see from the example output below, there are several running containers in Container Development Kit immediately after launch. These containers provide some of the services offered by Container Development Kit and as such should not be stopped or removed. The example below shows containers with the OpenShift service

Use the **`--format`** parameter to specify what information you want displayed about the individual containers (see the **`docker-ps(1)`** manual page for a list of available placeholders). For example:

```
~]$ docker ps --format "table
{{.ID}}\t{{.Image}}\t{{.Command}}\t{{.Status}}"
```

```
CONTAINER ID  IMAGE
COMMAND                  STATUS
ce4817df7620  prom/haproxy-exporter:latest
"/bin/go-run -haproxy"  Up 55 minutes
e38b37b6e13a  openshift3/ose-docker-registry:v3.1.1.6
"/bin/sh -c 'DOCKER_R"  Up 56 minutes
8abd50d2311f  openshift3/ose-pod:v3.1.1.6
"/pod"                   Up 56 minutes
6821a60044a8  openshift3/ose-haproxy-router:v3.1.1.6
"/usr/bin/openshift-r"  Up 56 minutes
5312e060116d  openshift3/ose-pod:v3.1.1.6
"/pod"                   Up 56 minutes
8c94cc0c049b  registry.access.redhat.com/openshift3/ose:v3.1.1.6
"/usr/bin/openshift s"  Up 59 minutes
```

6.3.3. Displaying Information about Container Resource Usage

Run the **`docker stats <container>`** command to display a live output showing resource-usage statistics for a specific running container. For example:

```
~]$ docker stats openshift
CONTAINER  CPU %  MEM USAGE / LIMIT    MEM %  NET I/O    BLOCK I/O
openshift  0.00%  110.4 MB / 2.986 GB  3.70%  0 B / 0 B  77.24 MB /
3.708 MB
```

6.3.4. Displaying Detailed Information about Container or Image Configuration

Run the **`docker inspect <container>`** command to show low-level information about a container or an image in JSON format. Use the **`--type`** parameter to specify whether you want to display information about a **`container`** (the default) or an **`image`** in case you have containers and images of the same name.

Use the **`--format`** parameter to specify what part of the output you want displayed (see the **`docker-inspect(1)`** manual page for examples of the output). For example, define the following format to list network ports exposed by the container:

```
~]$ docker inspect --format='{{.Config.ExposedPorts}}' openshift
map[8443/tcp:{} 53/tcp:{}]
```

6.4. GETTING NEW DOCKER-FORMATTED CONTAINER IMAGES

Existing images for creating containers can be either downloaded (pulled) from one of the two pre-configured repositories (the Docker Hub (*docker.io*) and the Red Hat Atomic Registry (*registry.access.redhat.com*)) or imported from a local file.

6.4.1. Searching Registries for Images

Run the **`docker search <search-term>`** command to search the pre-configured registries for images. For example, to search for images containing the string **`rhscl`** in the name or namespace, use the following command:

```
~]$ docker search rhscl
```

```
INDEX        NAME
DESCRIPTION                                     STARS  OFFICIAL
AUTOMAT
docker.io    docker.io/rhscl/mongodb-26-centos7
A Centos7 based MongoDB v2.6 image for use...   0
redhat.com   registry.access.redhat.com/rhscl/devtoolset-4-toolchain-
rhel7  Developer toolset toolchain                    0
redhat.com   registry.access.redhat.com/rhscl/httpd-24-rhel7
Apache HTTP 2.4 Server                          0
redhat.com   registry.access.redhat.com/rhscl/mariadb-100-rhel7
MariaDB 10.0 SQL database server                0
redhat.com   registry.access.redhat.com/rhscl/mongodb-26-rhel7
MongoDB 2.6 NoSQL database server               0
redhat.com   registry.access.redhat.com/rhscl/mysql-56-rhel7
MySQL 5.6 SQL database server                   0
redhat.com   registry.access.redhat.com/rhscl/nginx-16-rhel7
Nginx 1.6 server and a reverse proxy server     0
[...]
```

6.4.2. Downloading Images from a Registry

Run the **`docker pull <image>`** command to download (pull) the specified image to your system for local use. Note that while it is possible to provide just the name of the image, it is better practice to also specify the registry you want to pull from and the namespace in which the particular image is published. The naming convention follows this order: **`[registry/][namespace/]name`**.

For example, to pull the image with the toolchain components of the Red Hat Developer Toolset from the Red Hat Atomic Registry, use the following command:

```
~]$ docker pull registry.access.redhat.com/rhscl/devtoolset-4-
toolchain-rhel7
Using default tag: latest
68f6775524af: Download complete
6c3a84d798dc: Download complete
Status: Downloaded newer image for
registry.access.redhat.com/rhscl/devtoolset-4-toolchain-rhel7:latest

~]$ docker images registry.access.redhat.com/rhscl/devtoolset-4-
toolchain-rhel7
REPOSITORY                                                    TAG
IMAGE ID      CREATED      VIRTUAL SIZE
registry.access.redhat.com/rhscl/devtoolset-4-toolchain-rhel7  latest
68f6775524af  7 weeks ago  365.5 MB
```

6.4.3. Loading an Image from a File

Run the **`docker load < file.tar`** command to load an image from a local file **`file.tar`**. By default, the **`docker pull`** command loads image data from the standard input. To load an image from a file, use the **`--input`** or **`-i`** parameter. For example to load the Red Hat Developer Toolset toolchain image that was previously saved to a tar file using the **`docker save`** command, use the following command:

```
~]$ docker load -i devtoolset.tar
```

6.5. USING CONTAINERS

Use the following commands to launch, stop, or remove containers or to run applications from within containers.

6.5.1. Launching a New Container and Running a Command

Run the **`docker run <image> <command>`** command to launch a new container from an image and run the specified command. Use the **`--name`** parameter to specify a name for the container to prevent the Docker service from assigning a random name to the container. For example, to run the **`uname -a`** command (and display its output) in a container created from the Red Hat Developer Toolset toolchain image, use the following command:

```
~]$ docker run --name devtoolset
registry.access.redhat.com/rhscl/devtoolset-4-toolchain-rhel7 uname -a
Linux 22b819dec3f1 3.10.0-327.el7.x86_64 #1 SMP Thu Oct 29 17:29:29 EDT
2015 x86_64 x86_64 x86_64 GNU/Linux

~]$ docker ps -a --format "table
{{.ID}}\t{{.Names}}\t{{.Command}}\t{{.Status}}"
CONTAINER ID  NAMES       COMMAND     STATUS
22b819dec3f1  devtoolset  "uname -a"  Exited (0) 2 seconds ago
[...]
```

6.5.2. Stopping a Container

Run the **`docker stop <container>`** command to stop one or more containers. This action tries to gracefully shut down the applications running in the container by sending them the **`SIGTERM`** signal (followed by the **`SIGKILL`** signal if **`SIGTERM`** does not work). For example, to stop the container created in the previous example, use the following command:

```
~]$ docker stop devtoolset
devtoolset

~]$ docker ps | grep devtoolset
```

6.5.3. Starting an Existing Container

Use the **`docker start -i <container>`** command to run the container stopped in the previous example (the **`--interactive`** or **`-i`** parameter ensures that the container's standard output is attached to your current shell — in other words, it ensures that the output of the command executed in the container is displayed):

```
~]$ docker start -i devtoolset
Linux 22b819dec3f1 3.10.0-327.el7.x86_64 #1 SMP Thu Oct 29 17:29:29 EDT
2015 x86_64 x86_64 x86_64 GNU/Linux
```

6.5.4. Launching a New Container and Switching to the Container's Shell

Run the **docker run -ti <*image*> bash** command to launch a new container from an image and switch to an interactive shell within the container. The **--interactive** or **-i** parameter along with the **--tty** or **-t** parameter are used to allocate a pseudo-TTY within which the Bash shell is run. For example:

```
~]$ docker run -it registry.access.redhat.com/rhscl/devtoolset-4-
toolchain-rhel7 bash
bash-4.2$ uname -a
Linux 5e224c8c3878 3.10.0-327.el7.x86_64 #1 SMP Thu Oct 29 17:29:29 EDT
2015 x86_64 x86_64 x86_64 GNU/Linux
bash-4.2$ exit
exit

~]$ docker ps -a --format "table
{{.ID}}\t{{.Names}}\t{{.Command}}\t{{.Status}}"
CONTAINER ID  NAMES       COMMAND     STATUS
5e224c8c3878  devtoolset  "uname -a"  Exited (0) 2 seconds ago
[...]
```

6.5.5. Removing a Container

Run the **docker rm <*container*>** command to remove one or more containers, thus freeing the host's resources. For example, to remove the container created in the previous example, use the following command:

```
~]$ docker rm devtoolset
devtoolset

~]$ docker ps -a | grep devtoolset
```

6.6. ADDITIONAL RESOURCES

- See the **COMMANDS** section of the **docker(1)** manual page for a complete list of available **docker** commands and detailed descriptions of their function.
- See the Getting Started with Containers guide for detailed information about the use and management of containers on the Red Hat Enterprise Linux and Red Hat Atomic platforms.

CHAPTER 7. USING OPENSHIFT CONTAINER PLATFORM

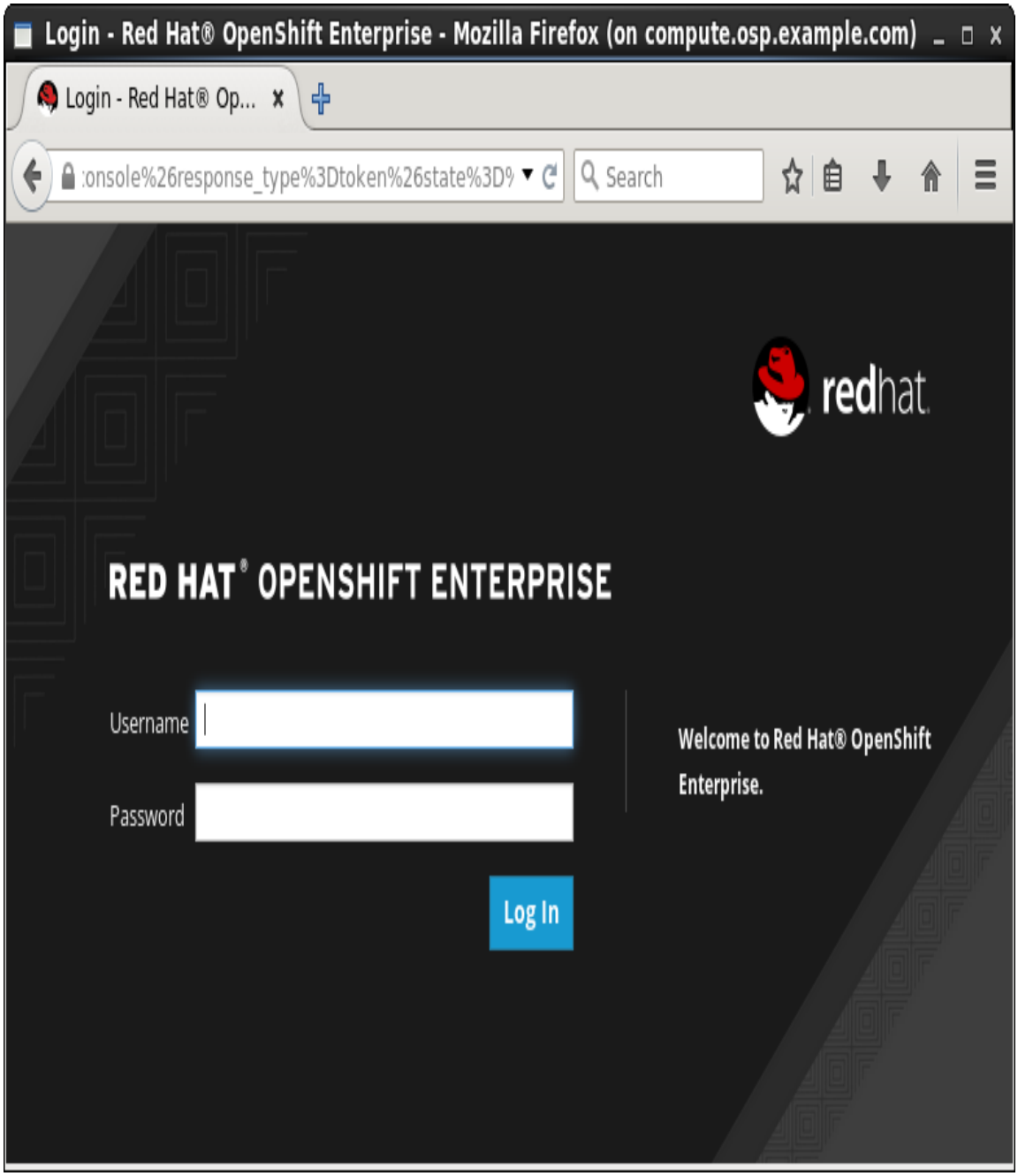
When you initialize the Container Development Kit Vagrant box using the **`rhel-ose`** Vagrantfile, which is provided as a part of Red Hat Container Tools (located in **`cdk/components/rhel/rhel-ose/Vagrantfile`** in the ZIP file), the launched virtual machine automatically provisions an instance of **OpenShift Container Platform**. (See the Red Hat Container Development Kit 2.3 Installation Guide for additional information on how to launch Container Development Kit with a specific Vagrantfile.)

Note

OpenShift Container Platform is a Platform as a Service (PaaS) offering by Red Hat that extends the functionality of the Docker service and the Kubernetes container orchestration tool to provide a powerful and easy-to-use platform for building, deploying, and orchestrating multi-container applications and services.

7.1. USING OPENSHIFT FROM THE WEB USER INTERFACE

1. Point your Web browser to the URL shown for the OpenShift console. The default is: https://10.1.2.2:8443/console.



2. Log in as either a basic user with the **`openshift-dev`** username and **`devel`** password or cluster admin user with the **`admin`** username and **`admin`** password.

7.1.1. Additional Resources

- For a walk-through of the OpenShift Web Console, see Developers: Web Console Walkthrough.
- For help creating your first OpenShift application, see Creating New Applications Using the Web Console.

7.2. USING OPENSHIFT FROM THE COMMAND LINE

Command-line usage of the OpenShift service provided by the Container Development Kit box is possible both from within the virtual machine and from the host machine. This section provides examples of basic usage of the **oc** command. Note that you can also administer a subset of OpenShift features using its web user interface, which is accesible at https://10.1.2.2:8443/console.

See also the OpenShift Container Platform Developer Guide for detailed instructions on how to set up and configure a workstation to develop and deploy applications in an OpenShift cloud environment with a command-line interface (CLI) and the web console.

7.2.1. Preparing Host System for Using OpenShift from the Command Line

To use the **oc** command on your host system to interact with the OpenShift service running inside the Container Development Kit virtual machine, you need to install the **oc** executable.

If you intend to use OpenShift (and the **oc** command) only from within the Container Development Kit virtual machine, no preparation is required — the **oc** command is installed in the Container Development Kit box by default.

7.2.1.1. Installing the oc Executable

Use the **`install-cli`** command of the **`vagrant-service-manager`** plugin to install the **oc** binary on your host system.

For example:

```
~]$ vagrant service-manager install-cli openshift
# Binary now available at /home/joe/.vagrant.d/data/service-
manager/bin/openshift/1.2.1/oc
# run binary as:
# oc <command>
export PATH=/home/joe/.vagrant.d/data/service-
manager/bin/openshift/1.2.1:$PATH

# run following command to configure your shell:
# eval "$(VAGRANT_NO_COLOR=1 vagrant service-manager install-cli
openshift | tr -d '\r')"
```

Note

To use the **`install-cli`** command when behind a proxy, the Container Development Environment needs to be configured to operate behind a proxy using the **`vagrant-service-manager`** plugin. See section Using vagrant-service-manager to Set Proxy Environment Variables in the Red Hat Container Development Kit 2.3 Installation Guide.

7.2.1.1.1. Installing a Custom Version of the oc Binary

By default, the **`install-cli`** command installs the **oc** binary from the upstream OpenShift Origin project in version 1.2.1. To install a different version, use the **`--cli-version`** option.

```
~]$ vagrant service-manager install-cli openshift --cli-version 1.3.1
# Binary now available at /home/joe/.vagrant.d/data/service-
manager/bin/openshift/1.3.1/oc
# run binary as:
# oc <command>
export PATH=/home/joe/.vagrant.d/data/service-
manager/bin/openshift/1.3.1:$PATH
```

```
# run following command to configure your shell:
# eval "$(VAGRANT_NO_COLOR=1 vagrant service-manager install-cli
openshift --cli-version 1.3.1 | tr -d '\r')"
```

7.2.1.1.2. Installing the oc Binary to a Custom Location

By default, the **`install-cli`** command installs the **`oc`** binary from the upstream OpenShift Origin project to the following directory: **`/home/joe/.vagrant.d/data/service-manager/bin/openshift/1.2.1/`**. To install the executable to a different location, use the **`--path`** option. Note that you need to specify an existing directory and the name of the binary.

For example:

```
~]$ vagrant service-manager install-cli openshift --cli-version 1.3.1 -
-path ~/bin/oc
# Binary now available at /home/joe/bin/oc
# run binary as:
# oc <command>
export PATH=/home/joe/bin:$PATH

# run following command to configure your shell:
# eval "$(VAGRANT_NO_COLOR=1 vagrant service-manager install-cli
openshift --path /home/joe/bin/oc --cli-version 1.3.1 | tr -d '\r')"
```

7.2.2. Verifying the OpenShift Installation

Upon initializing the Container Development Kit Vagrant box using the **`rhel-ose`** Vagrantfile, the following information is output about the OpenShift service that has been provisioned for you:

```
You can now access the OpenShift console on:
https://10.1.2.2:8443/console

To use OpenShift CLI, run:
$ vagrant ssh
$ oc login 10.1.2.2:8443

Configured users are (<username>/<password>):
openshift-dev/devel
admin/admin

If you have the oc client library on your host, you can also login from
your host.
```

The automatically provisioned instance of OpenShift Container Platform in Container Development Kit is provided in the form of a container. You can check that the OpenShift container is installed and running by examining the output of the **`docker ps`** command:

```
~]$ docker ps
CONTAINER ID  IMAGE      COMMAND                CREATED      STATUS
PORTS  NAMES
...
ddb2d13604ef  openshift  "/usr/bin/openshift s"  2 hours ago  Up 2
hours         openshift
```

You can also run a health check to determine whether OpenShift is running properly by querying its network interface using the **`curl`** command:

```
~]$ curl -k https://10.1.2.2:8443/healthz
ok
```

7.2.3. Displaying Information about the OpenShift Service

The command-line interface of OpenShift is accessed using the **oc** command. This command has a number of subcommands that help to interact with various features of the OpenShift service. This section describes how to use the **oc** command to gather basic information about the current OpenShift instance.

7.2.3.1. Checking the Version of OpenShift and Kubernetes

Use the **`oc version`** command to display the version of OpenShift Container Platform and the Kubernetes service currently in use:

```
~]$ oc version
oc v3.1.0.4-16-g112fcc4
kubernetes v1.1.0-origin-1107-g4c8e6f4
```

7.2.4. Logging in and out of the OpenShift Server

Use the **`oc login`** command to log into specific user profiles. Upon start up, the Container Development Kit box logs you in automatically to the **`openshift-dev`** account.

7.2.4.1. Logging in to the OpenShift Server

Use the **`oc login`** command to log into the OpenShift server. If you want to log in from your host system, you need to specify a host address (10.1.2.2:8443). The command asks for the username and password interactively, but you can also supply this information on the command line using the **`-u`** (**`--username`**) and **`-p`** (**`--password`**) options respectively. For example, to log into the default OpenShift instance in Container Development Kit from your host system, use the following command:

```
~]$ oc login -u openshift-dev -p devel https://10.1.2.2:8443
x509: certificate signed by unknown authority
You can bypass the certificate check, but any data you send to the
server could be intercepted by others.
Use insecure connections? (y/n): y

Authentication required for https://10.1.2.2:8443 (openshift)
Username: openshift-dev
Password:
Login successful.

You have access to the following projects and can switch between them
with 'oc project <projectname>':
```

```
  * sample-project (current)

Using project "sample-project".
Welcome! See 'oc help' to get started.
```

Note

Use the **`--insecure-skip-tls-verify=true`** option with the **`oc login`** command to prevent the warning about insecure connection.

Use the **`oc whoami`** command to check the user account to which you are currently logged:

```
~]$ oc whoami
openshift-dev
```

7.2.4.2. Viewing Current OpenShift CLI Configuration

To display the configuration values for the command-line environment, use the **`oc config view`**. For example, to show the part of the configuration pertaining to the default user name (**`openshift-dev`**), issue the following command:

```
~]$ oc config view | grep -A2 "name: openshift-dev"
- name: openshift-dev/10-1-2-2:8443
  user:
    token: THdHS4sw1qgzs95CnCf5ic6D8eOrZss1aT5jyGOmd2w
```

7.2.4.3. Logging out of the OpenShift Server

To log out, use the **`oc logout`** command:

```
~]$ oc logout
Logged "openshift-dev" out on "https://10.1.2.2:8443"
```

7.2.5. Working with OpenShift Projects

In OpenShift, projects are used to organize and manage applications by groups of users. Individual projects keep their content separated from each other, and individual users need to be granted access to projects. Upon start up, the Container Development Kit box automatically creates the **`sample-project`** project.

7.2.5.1. Creating a New OpenShift Project

Use the **`oc new-project`** command to create a new project on the OpenShift server you are currently logged in to. The following example uses the optional **`--display-name`** option to set a user-friendly name for the project:

```
~]$ oc new-project testing --display-name="Test Project"
Now using project "testing" on server "https://127.0.0.1:8443".

You can add applications to this project with the 'new-app' command.
```

```
For example, try:

    $ oc new-app centos/ruby-22-
centos7~https://github.com/openshift/ruby-hello-world.git

to build a new hello-world application in Ruby.
```

7.2.5.2. Switching to a Different OpenShift Project

Use the **`oc project <project-name>`** command to switch to another project on the OpenShift server you are currently logged in to. The following switches to the default **`sample-project`** project:

```
~]$ oc project sample-project
Now using project "sample-project" on server "https://10.1.2.2:8443".
```

7.2.5.3. Listing Available Projects

To list projects available on the server and their status, use the **`oc get projects`** command. Note that the **`oc get`** command can be used to display information about a number of other resources besides projects (pods, builds, services, etc.). In the following example, only the project created in the preceeding example is shown:

```
~]$ oc get project
NAME      DISPLAY NAME   STATUS
testing   Test Project   Active
```

7.2.5.4. Displaying Status Information about the Currently Used Project

Run the **`oc status`** command to display information about the currently used project and about activities (services, builds, deployments, etc.) within that project. When executed in a new (empty) project, the output looks like the following:

```
~]$ oc status
In project Test Project (testing) on server https://10.1.2.2:8443

You have no services, deployment configs, or build configs.
Run 'oc new-app' to create an application.
```

Alternatively, you can also use the **`oc project`** command to display project information:

```
~]$ oc project
Using project "testing" from context named "testing/10-1-2-
2:8443/openshift-dev" on server "https://10.1.2.2:8443".
```

7.2.5.5. Deleting a Project

To remove a project from the server, use the **`oc delete project`** command and specify the name of the project you want deleted. To remove all projects, include the **`--all`** option. Note that the **`oc delete`** command can be used to delete other resources (pods, services, etc.) as well. For example, to delete the project created in this section, run the following command:

```
~]$ oc delete project testing
project "testing" deleted
```

7.2.6. Working with OpenShift Templates

A *template* in OpenShift is a text file (in the JSON or YAML format) that defines a set of objects. The object definitions, such as services or build configurations, can be parametrized. Templates can be processed to create the objects they describe and thus populate your current project.

To get you quickly started with application development, OpenShift offers a number of basic templates, which are included in the global **openshift** project. In order to use these templates as the foundation block of a new application, they need to be downloaded from the **openshift** project and subsequently uploaded to your current project. You can also create a new application (using the **oc new-app** command) directly from a template.

7.2.6.1. Listing Available Templates

To display the templates available in a project, issue the **oc get templates** command and use the **-n** option to specify the project from which you wish to list the templates. For example, to list the templates available in the global **openshift** project, run:

```
~]$ oc get templates -n openshift
NAME                                DESCRIPTION
PARAMETERS     OBJECTS
cakephp-example                     An example CakePHP application...
15 (8 blank)   5
cakephp-mysql-example               An example CakePHP application...
16 (3 blank)   7
eap64-basic-s2i                     Application template for EAP 6...
12 (3 blank)   5
eap64-mysql-persistent-s2i          Application template for EAP 6...
34 (16 blank)  10
jws30-tomcat7-mysql-persistent-s2i  Application template for JWS M...
28 (11 blank)  10
nodejs-example                      An example Node.js application...
12 (8 blank)   5
nodejs-mongodb-example              An example Node.js application...
13 (3 blank)   7
```

There are also templates bundled with the Container Development Environment. Find them in the **/opt/adb/openshift/templates/common** directory:

```
~]$ ls -1 /opt/adb/openshift/templates/common/
cakephp.json
cakephp-mysql.json
eap64-basic-s2i.json
eap64-mysql-persistent-s2i.json
image-streams.json
jboss-image-streams.json
jenkins-ephemeral-template.json
jenkins-persistent-template.json
jenkins-slave-template.json
```

```
jws30-tomcat7-mysql-persistent-s2i.json
nodejs.json
nodejs-mongodb.json
wildfly-image-streams.json
```

Note

Please note that not all OpenShift templates that are listed in OpenShift and xPaaS documentation are available as a part of the Container Development Environment — only a subset of the templates has been tested with the Container Development Environment. Also, in the Container Development Environment, the templates are located in the **`/opt/adb/openshift/templates/common`** directory, not in **`/usr/share/openshift/examples/`**. For example, the **`xpaas-streams`** template mentioned in OpenShift Source-to-Image (S2I) Workflow is not in the Container Development Environment.

To use the templates that are not included by default, download them from their upstream GitHub repositories:

- JBoss Fuse Integration Services templates: jboss-fuse/application-templates
- JBoss Middleware templates: jboss-openshift/application-templates

See Can't find Fuse Integration Services (FIS) or A-MQ xPaaS image templates for further information.

7.2.6.2. Downloading an InstantApp Template

To obtain a template definition file, which can be used for uploading to your project, use the **`oc get templates`** command and specify the project in which the template is located (using the **`-n`** or **`--namespace`** option), choose the format in which you wish to store the template (typically JSON or YAML — use the **`-o`** or **`--output`** option), and supply the name of the requested template. Note that by default, the **`oc get`** command outputs the requested data to the standard output. To store the template in a file, redirect the output of the command to a file.

For example, to download the **`nodejs-mongodb-example`** template from the global **openshift** project and save it in the JSON format on your local syastem, use the following command:

```
~]$ oc get templates -o json -n openshift nodejs-mongodb-example \ >
nodejs-mongodb-example.json

~]$ ls
nodejs-mongodb-example.json
```

7.2.6.3. Modifying the Namespace (Project Name)

When you download an InstantApp template from the default **openshift** project, the namespace (project name) in the template is set to **`openshift`**. To be able to upload the template to your project, you need to modify the template accordingly. If you do not do that, the upload fails with the following error message:

```
~]$ oc create -f nodejs-mongodb-example.json -n testing
the namespace from the provided object "openshift" does not match the
namespace "testing". You must pass '--namespace=openshift' to perform
this operation.
```

To modify the namespace, edit the file using a text editor, such as **vi**, and in the **metadata** section, replace the value of the **namespace** parameter with the name of your project. For example, to use the name **testing**, the beginning of the **nodejs-mongodb-example.json** template file would look like this:

```
{
    "kind": "Template",
    "apiVersion": "v1",
    "metadata": {
        "name": "nodejs-mongodb-example",
        "namespace": "testing",
[...]
```

7.2.6.4. Uploading a Template to the Current Project

For a template to be available for use in your project, it must be first uploaded to it. Use the **oc create** command to do this and specify the template file using the **-f** or **--filename** option. For example, to upload the **nodejs-mongodb-example** InstantApp template obtained from the **openshift** project, run the following command:

```
~]$ oc create -f nodejs-mongodb-example.json
template "nodejs-mongodb-example" created
```

To verify that the template has been successfully uploaded, use the **oc get templates** command. Optionally, you can specify the namespace from which you wish to list by using the **-n** or **--namespace** option. By default, templates from the currently used project are listed:

```
~]$ oc get templates
NAME                     DESCRIPTION
PARAMETERS     OBJECTS
nodejs-mongodb-example   An example Node.js application with a MongoDB
database   11 (3 blank)   7
```

7.2.6.5. Listing Template Parameters

To list the parameters that a template specifies along with short descriptions and predefined values, use the **oc process** command with the **--parameters** option. For example, to list the parameters used by the **nodejs-mongodb-example** template, use the following command:

```
~]$ oc process --parameters nodejs-mongodb-example
NAME                     DESCRIPTION
GENERATOR   VALUE
SOURCE_REPOSITORY_URL    The URL of the repository with your...
https://github.com/openshift/nodejs-ex.git
SOURCE_REPOSITORY_REF    Set this to a branch name, tag or ot...
CONTEXT_DIR              Set this to the relative path to you...
APPLICATION_DOMAIN       The exposed hostname that will route...
GITHUB_WEBHOOK_SECRET    A secret string used to configure th...
```

```
expression  [a-zA-Z0-9]{40}
GENERIC_WEBHOOK_SECRET   A secret string used to configure th...
expression  [a-zA-Z0-9]{40}
DATABASE_SERVICE_NAME    Database service name
mongodb
DATABASE_USER            Username for MongoDB user that will...
expression  user[A-Z0-9]{3}
DATABASE_PASSWORD        Password for the MongoDB user
expression  [a-zA-Z0-9]{16}
DATABASE_NAME            Database name
sampledb
DATABASE_ADMIN_PASSWORD  Password for the database admin user...
expression  [a-zA-Z0-9]{16}
```

7.2.6.6. Creating Objects from a Template

To process a template and use it to create the objects it defines in your project, use a combination of the **`oc process`** and **`oc create`** commands. The template processed by the **`oc process`** command can be piped to the **`oc create`** command.

Note that in most cases, the template parameters need to be modified, so that the resulting application can be useful in a real-world scenario. To modify the template parameters when creating the objects, use the **`-v`** or **`--value`** option.

For example, to create objects using the **`nodejs-mongodb-example`** template and to set a different source repository for the application (the original repository would need to be forked to the repository specified on the command line), use the following combination of commands:

```
~]$ oc process nodejs-mongodb-example \
-v SOURCE_REPOSITORY_URL=https://github.com/username/nodejs-ex.git | \
oc create -f -
service "nodejs-mongodb-example" created
route "nodejs-mongodb-example" created
imagestream "nodejs-mongodb-example" created
buildconfig "nodejs-mongodb-example" created
deploymentconfig "nodejs-mongodb-example" created
service "mongodb" created
deploymentconfig "mongodb" created
```

In the above example, substitute ***`username`*** for the name of the GitHub account into which the original repository was forked.

7.2.7. Additional Resources

- See the output of the **`oc help`** command for an overview of all **`oc`** subcommands available. More detailed help for individual subcommands can be accessed by running **`oc help`** ***`[subcommand]`***.
- See the OpenShift Container Platform CLI Reference for detailed descriptions of the command-line user interface used to interact with OpenShift Container Platform.
- See the OpenShift Container Platform Developer Guide for detailed instructions and examples to help developers configure a workstation to develop and deploy applications in an OpenShift Container Platform cloud environment with a command-line interface.

CHAPTER 8. DEPLOYING AN APPLICATION ON OPENSHIFT

This section describes how to use OpenShift to create containerized applications and deploy them on an OpenShift cluster. The examples in this section use only basic features of the OpenShift service and are for demonstration purposes only. See the CDK Developer Guide (to be published) for more in-depth descriptions.

8.1. DEPLOYING AN INSTANTAPP TEMPLATE AS A NEW APPLICATION

In this example, an InstantApp template available from the default **openshift** project is used to create and deploy a web application. The definition of the template sets all necessary configuration options. A good way to experiment with OpenShift deployments is to clone the example's repository and modify different parts of the defined template.

8.1.1. Creating a New OpenShift Application from a Template

To use a template to directly create a new application, run the **`oc new-app`** command with the **`--template`** option specifying the template you want to use as the basis for your application. For example, to use the **`nodejs-example`** InstantApp template, run the following command:

```
~]$ oc new-app --template=nodejs-example
--> Deploying template nodejs-example in project openshift for "nodejs-
example"
     With parameters:
      Memory Limit=512Mi
      Git Repository URL=https://github.com/openshift/nodejs-ex.git
      Git Reference=
      Context Directory=
      Application Hostname=
      GitHub Webhook Secret=UKWP4bVymgjXcNMVnHIdaVeaORt3NMPuyqAEHhLv #
generated
      Generic Webhook Secret=wabGtSM7g5eSykRuH5aCskWKdFOXB0UxyNNrnQyr #
generated
      Database Service Name=
      MongoDB Username=
      MongoDB Password=
      Database Name=
      Database Administrator Password=
--> Creating resources with label app=nodejs-example ...
    Service "nodejs-example" created
    Route "nodejs-example" created
    ImageStream "nodejs-example" created
    BuildConfig "nodejs-example" created
    DeploymentConfig "nodejs-example" created
--> Success
    Build scheduled for "nodejs-example" - use the logs command to
track its progress.
    Run 'oc status' to view your app.
```

8.1.2. Monitoring Deployment Progress

To monitor the progress of the deployment, use the **`oc status`** command, optionally with the **`-v`** (**`--verbose`**) parameter to display information about potential warnings:

```
~]$ oc status -v
In project OpenShift sample project (sample-project) on server
https://127.0.0.1:8443

svc/nodejs-example - 172.30.142.222:8080
  dc/nodejs-example deploys imagestreamtag/nodejs-example:latest <-
    bc/nodejs-example builds https://github.com/openshift/nodejs-ex.git
with openshift/nodejs:0.10
      #1 build running for 27 seconds
    #1 deployment waiting on image or update
  exposed by route/nodejs-example

Warnings:
  * The image trigger for dc/nodejs-example will have no effect until
imagestreamtag/nodejs-example:latest is imported or created by a build.

View details with 'oc describe <resource>/<name>' or list everything
with 'oc get all'.
```

8.1.3. Displaying Information about a Deployed Service

The application is automatically deployed when the build completes. Use the **`oc describe`** command to display information about different parts of the application (or use the **`oc get all`** command to display all information at once).

To see summary information about the service, use:

```
~]$ oc describe svc/nodejs-example
Name:                   nodejs-example
Namespace:              sample-project
Labels:                 app=nodejs-example,template=nodejs-example
Selector:               name=nodejs-example
Type:                   ClusterIP
IP:                     172.30.142.222
Port:                   web     8080/TCP
Endpoints:              172.17.0.2:8080
Session Affinity:       None
No events.
```

To display information about the route established for the application, use:

```
~]$ oc describe route/nodejs-example
Name:                   nodejs-example
Created:                46 minutes ago
Labels:                 app=nodejs-example,template=nodejs-example
Annotations:            openshift.io/generated-by=OpenShiftNewApp
                        openshift.io/host.generated=true
Host:                   nodejs-example-sample-project.rhel-
cdk.10.1.2.2.xip.io
```

```
Path:                   <none>
Service:                nodejs-example
TLS Termination:        <none>
Insecure Policy:        <none>
```

The above command shows that the deployed application can be accessed at nodejs-example-sample-project.rhel-cdk.10.1.2.2.xip.io (the URL is made available through the external **xip.io** DNS service).

You can point a web browser from your host system at this address to see the page generated by the application. To check whether the application is running properly from the command line, either use a text-mode browser like **lynx** or download the page using **`curl`**:

```
~]$ curl nodejs-example-sample-project.rhel-cdk.10.1.2.2.xip.io 2>
/dev/null | grep '<h1>'
            <h1>Welcome to your Node.js application on OpenShift</h1>
```

8.1.4. Learning about Service Images and Containers

To check the Docker images and containers that form the application, use the **`docker images`** and **`docker ps`** commands:

```
~]$ docker images
REPOSITORY                                          TAG     IMAGE ID
CREATED      VIRTUAL SIZE
172.30.254.28:5000/sample-project/nodejs-example  latest  bc19f3f7dd86
2 hours ago  432.6 MB
172.30.254.28:5000/sample-project/nodejs-example  <none>  bc19f3f7dd86
2 hours ago  432.6 MB

[...]

~]$ docker ps
CONTAINER ID  IMAGE
COMMAND                 CREATED      STATUS      NAMES
bcafafb013ce  172.30.254.28:5000/sample-project/nodejs-
example@sha256:...  "container-entrypoint"  2 hours ago  Up 2 hours
k8s_nodejs-example.27445d76_nodejs-example-1-hdq11_sample-
project_e5c69b57-0496-11e6-907d-525400806d1b_3e6e6b39
d4f52a47cb10  openshift3/ose-pod:v3.1.1.6
"/pod"                  2 hours ago  Up 2 hours
k8s_POD.5983fd1a_nodejs-example-1-hdq11_sample-project_e5c69b57-0496-
11e6-907d-525400806d1b_b3dee3ea

[...]
```

8.2. DEPLOYING A 'HELLO WORLD' APPLICATION USING NODE.JS

In this example, a very simple Node.js web application is created. The application is defined using a minimalistic build strategy that is automatically downloaded from a Git repository (in this case, GitHub is used). The built application is deployed on top of a Node.js container pulled from the Red Hat Atomic Registry.

8.2.1. Preparing the Application Source Code

Create a new repository on GitHub. For the purposes of this example, we will assume that the created repository has the following URL: **http://github.com/example/nodejs-hello-world.git**. Then upload a basic Node.js application to the root directory of the repository. Name the file **helloworld.js**.

```
var http = require('http');

var server = http.createServer(function(req, res) {
  res.writeHead(200);
  res.end('Hello World');
});
server.listen(8080);
```

The application creates an HTTP server listening on port 8080 and prints **Hello World** when accessed. Download the **helloword.js** file.

8.2.2. Preparing the Definition of an OpenShift Application

Upload the following minimal definition of a Node.js OpenShift application to the GitHub repository. Name the file **package.json**. Based on the name of the file, OpenShift automatically selects the appropriate builder (**nodejs**, in this case).

```
{
  "name": "nodejs-hello-world",
  "version": "0.0.1",
  "description": "Node.js Hello World for OpenShift 3",
  "main": "helloworld.js", 1
  "dependencies": {
    "ejs": "^2.4.1", 2
    "express": "^4.13.4"
  },
  "scripts": {
    "start": "node helloworld.js" 3
  },
  "repository": {
    "type": "git",
    "url": "http://github.com/rkratky/nodejs-hello-world.git"
  }
}
```

1

Application source file

2

Required build dependencies—automatically supplied by **npm** (Node.js package manager)

3

Command to execute

Download the **package.json** file.

8.2.3. Creating a New OpenShift Application

To create a new application in OpenShift, use the **oc new-app** command. OpenShift automatically performs the following steps:

1. downloads required dependencies, including specified Docker-formatted container images,
2. pulls latest source code and application definition from the specified location (a Git repository, in this case),
3. builds the application source code,
4. builds a container with the resulting application,
5. deploys the application container.

In this example, the required Node.js container image from the Red Hat Atomic Registry is specified along with the URL of the Git repository:

```
~]$ oc new-app registry.access.redhat.com/openshift3/nodejs-010-
rhel7~https://github.com/example/nodejs-hello-world.git
--> Found Docker image 92eee82 (6 weeks old) from
registry.access.redhat.com for
"registry.access.redhat.com/openshift3/nodejs-010-rhel7"
    * An image stream will be created as "nodejs-010-rhel7:latest" that
will track the source image
    * A source build using source code from
https://github.com/example/nodejs-hello-world.git will be created
      * The resulting image will be pushed to image stream "nodejs-
hello-world:latest"
      * Every time "nodejs-010-rhel7:latest" changes a new build will
be triggered
    * This image will be deployed in deployment config "nodejs-hello-
world"
    * Port 8080/tcp will be load balanced by service "nodejs-hello-
world"
--> Creating resources with label app=nodejs-hello-world ...
    ImageStream "nodejs-010-rhel7" created
    ImageStream "nodejs-hello-world" created
    BuildConfig "nodejs-hello-world" created
    DeploymentConfig "nodejs-hello-world" created
    Service "nodejs-hello-world" created
--> Success
    Build scheduled for "nodejs-hello-world" - use the logs command to
track its progress.
    Run 'oc status' to view your app.
```

8.2.4. Monitoring Build Progress

Use the **`oc describe build`** command to display information about the build currently in progress:

```
~]$ oc describe build
Name:           nodejs-hello-world-1
Created:        35 seconds ago
Labels:         app=nodejs-hello-world,buildconfig=nodejs-hello-
world,openshift.io/build-config.name=nodejs-hello-world
Annotations:    openshift.io/build.number=1
                openshift.io/build.pod-name=nodejs-hello-world-1-build
Build Config:   nodejs-hello-world
Started:        2016-04-18 07:05:25 -0400 EDT
Duration:       running for 25s
Build Pod:      nodejs-hello-world-1-build
Strategy:       Source
URL:            https://github.com/rkratky/nodejs-hello-world.git
From Image:     DockerImage
registry.access.redhat.com/openshift3/nodejs-010-rhel7:latest
Output to:      ImageStreamTag nodejs-hello-world:latest
Push Secret:    builder-dockercfg-9000s
Status:         Running
Events:
  FirstSeen     LastSeen    Count   From                SubobjectPath
Reason     Message
  ─────────    ────────   ─────   ────                ─────────────
──────     ───────
  34s           34s         1       {scheduler }
Scheduled  Successfully assigned nodejs-hello-world-1-build to rhel-cdk
  32s           32s         1       {kubelet rhel-cdk}  implicitly
required container POD  Pulled     Container image "openshift3/ose-
pod:v3.1.1.6" already present on machine
  30s           30s         1       {kubelet rhel-cdk}  implicitly
required container POD  Created    Created with docker id 462325c7c721
  29s           29s         1       {kubelet rhel-cdk}  implicitly
required container POD  Started    Started with docker id 462325c7c721
  29s           29s         1       {kubelet rhel-cdk}
spec.containers{sti-build}         Pulled     Container image
"openshift3/ose-sti-builder:v3.1.1.6" already present on machine
  27s           27s         1       {kubelet rhel-cdk}
spec.containers{sti-build}         Created    Created with docker id
f5bcba8891c3
  26s           26s         1       {kubelet rhel-cdk}
spec.containers{sti-build}         Started    Started with docker id
f5bcba8891c3
```

To see the build logs, use the **`oc logs`** command and specify the build you are interested in:

```
~]$ oc logs build/nodejs-hello-world-1
---> Installing application source
---> Building your Node application from source
E0418 09:17:59.264104  1 util.go:91] npm info it worked if it ends with
ok
E0418 09:17:59.265357  1 util.go:91] npm info using npm@2.14.13
E0418 09:17:59.265366  1 util.go:91] npm info using node@v0.10.40
E0418 09:18:00.697173  1 util.go:91] npm WARN package.json nodejs-
hello-world@0.0.1 No license field.
```

```
E0418 09:18:00.720236  1 util.go:91] npm info preinstall nodejs-hello-
world@0.0.1
E0418 09:18:00.828498  1 util.go:91] npm info attempt registry request
try #1 at 09:18:00

[...]
```

8.2.5. Displaying Information about the Deployed Service

Use the **`oc describe`** command and specify the service you are interested in to show summary information about the created service:

```
]$ oc describe svc/nodejs-hello-world
Name:              nodejs-hello-world
Namespace:         sample-project
Labels:            app=nodejs-hello-world
Selector:          app=nodejs-hello-world,deploymentconfig=nodejs-
hello-world
Type:              ClusterIP
IP:                172.30.166.144
Port:              8080-tcp        8080/TCP
Endpoints:         172.17.0.4:8080
Session Affinity:  None
No events.
```

Similarly, you can specify the deployment to show information about it, including the containers that have been created and deployed for the application:

```
~]$ oc describe dc
Name:           nodejs-hello-world
Created:        2 minutes ago
Labels:         app=nodejs-hello-world
Annotations:    openshift.io/generated-by=OpenShiftNewApp
Latest Version: 1
Triggers:       Config, Image(nodejs-hello-world@latest, auto=true)
Strategy:       Rolling
Template:
  Selector:     app=nodejs-hello-world,deploymentconfig=nodejs-hello-
world
  Replicas:     1
  Containers:
  NAME                  IMAGE
ENV
  nodejs-hello-world    172.30.91.119:5000/sample-project/nodejs-hello-
world@sha256:d97a0c44759c93b4231691813c12b5d2975c78fbee028f6c0091d97ed3
816678
Deployment #1 (latest):
  Name:         nodejs-hello-world-1
  Created:      2 minutes ago
  Status:       Complete
  Replicas:     1 current / 1 desired
  Selector:     app=nodejs-hello-world,deployment=nodejs-hello-world-
1,deploymentconfig=nodejs-hello-world
```

```
  Labels:       app=nodejs-hello-world,openshift.io/deployment-
config.name=nodejs-hello-world
  Pods Status:  1 Running / 0 Waiting / 0 Succeeded / 0 Failed
No events.
```

8.2.6. Testing the Running Application

To verify that the deployed HTTP server works correctly and serves the message specified in the application source code, you can use, for example, the **`curl`** tool:

```
~]$ curl 172.17.0.4:8080
Hello World
```

The IP address is shown, for example, in the description of the deployed service or pod. Use the **`oc get pods`** to list all pods:

```
~]$ oc get pods
NAME                          READY    STATUS      RESTARTS   AGE
nodejs-hello-world-1-1b5xi    1/1      Running     0          2m
nodejs-hello-world-1-build    0/1      Completed   0          2m
```

Use the name of the pod to display its description and grep for its IP address:

```
~]$ oc describe pod/nodejs-hello-world-1-1b5xi | grep IP
IP:                           172.17.0.4
```

8.3. ADDITIONAL RESOURCES

- See the definition of InstantApp OpenShift templates at https://github.com/openshift for inspiration.
- See the OpenShift Container Platform Developer Guide for detailed instructions on how to prepare, build, and deploy containerized applications on OpenShift.
- See the video tutorials and demonstration for developers at the OpenShift YouTube channel.

CHAPTER 9. USING THE KUBERNETES SERVICE

When you run **`vagrant up`** from the **`rhel-k8s-singlenode-setup`** directory, the Vagrantfile starts a Red Hat Enterprise Linux virtual machine from the Vagrant box you installed. The characteristics of that box are as follows:

- Starts the Docker service.
- Starts all the services needed to run an all-in-one Kubernetes master and node in the Red Hat Enterprise Linux VM.

The resulting virtual machine is ready to start using the **`kubectl`** command to build Kubernetes pods, services, replication controllers, and other features.

1. Change to the rhel-docker-eclipse directory and start the Red Hat Enterprise Linux VM (for Microsoft Windows, use **`%USERPROFILE%\cdk\components\rhel\rhel\rhel-k8s-singlenode-setup`**):

```
$ cd ~/cdk/components/rhel/misc/rhel-k8s-singlenode-setup/
$ vagrant up
```

2. Use **`vagrant ssh`** to access the Red Hat Enterprise Linux VM and check the status of kubernetes:

```
$ vagrant ssh

[vagrant@localhost ~]$ kubectl cluster-info
Kubernetes master is running at http://localhost:8080
```

3. Begin using your Red Hat Enterprise Linux Kubernetes-enabled VM.

9.1. ADDITIONAL RESOURCES

- For information on developing containerized applications to run in Kubernetes, see the Launching container pods with Kubernetes section of the *Get Started Orchestrating Containers with Kubernetes* guide.