



# **SERENA<sup>®</sup>** **DIMENSIONS<sup>®</sup> CM 14.3.2**

## **Docker Registry Guide**

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# Chapter 1

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## Introduction

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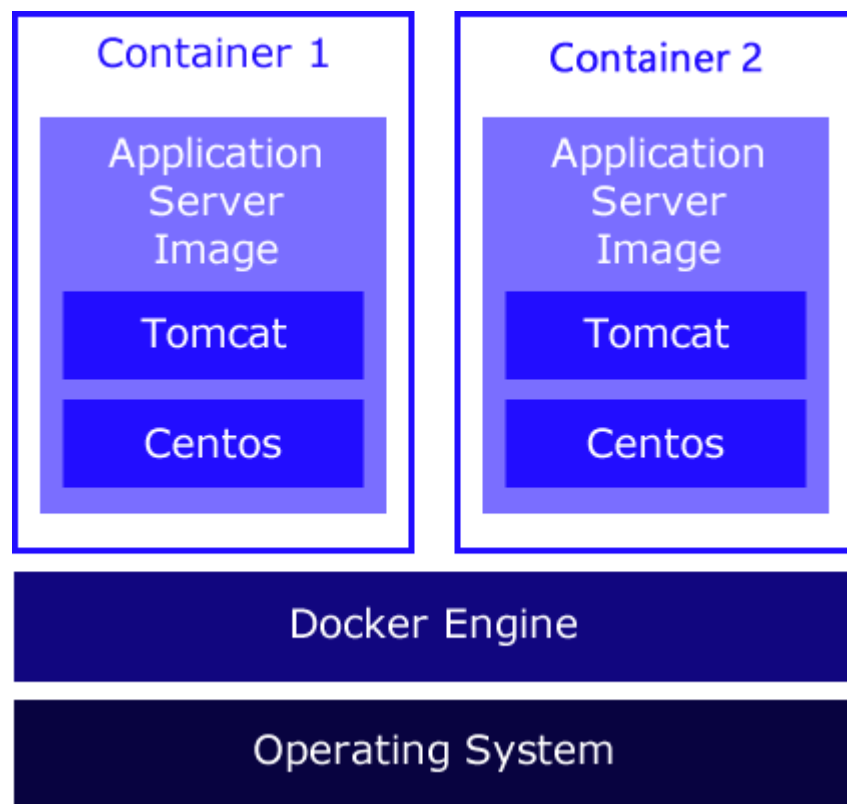
---

# What is Docker?

Docker enables you to create lightweight environments, called *containers*, in which you can run applications (Docker images). Containers run as isolated processes on a host operating system and are not tied to any specific infrastructure. Docker runs on any machine, on any infrastructure, and on any cloud. Images are stored in a Docker Registry.

An image's environment, such as an application and the dependencies required to run it, are stored in layers. Containers share the host operating system kernel with other containers. Containers start and stop instantly and make more efficient use of RAM. You can run multiple containers of the same image.

In the example below there are two containers, each running the same application server image comprised of two layers, Tomcat and Centos. The containers are running on the same Docker Engine and share the host operating system.



Docker is a commercial company, for information see this web site:

<https://www.docker.com/what-docker>

# Dimensions CM Integration with Docker

The Dimensions CM integration provides a Docker Private Registry for your images and has the following key features.

- Stores and version controls images. Changes to images over time are recorded so that you can recall specific versions later.
- Provides an audit trail of all changes to each image.
- Uses CM privileges and roles assignments to control which images can be pulled (downloaded). An image is only visible to the user who created it but is available to other users *after* it has been approved. For details about privileges, roles assignments, and relationships see the *Process Configuration Guide*.
- Enables change control of Docker images using Dimensions CM requests.

Dimensions CM Docker Registry images are stored in a secure CM repository:

- Each time an image is pushed (delivered) to CM a new baseline is created.
- Each image is a new design part.
- Each layer in an image is a new item with a unique filename.
- Layers can be shared between images using CM's usage relationships.

Baseline of Docker image

Layers in this Docker image

Design part for this Docker image

Requests related to this Docker image

ID	Status
INSURANCESVC-TURNOVER-1	CREATED

Filename	Revision
a3ed95caeb02ffe68cdd9fd84406680ae93d633cb16422d00e8a7c22955b46d4	java_s1_1#1
ab4d5223191a84176704dbc35963aadbcdb2b946ea0cc245b78ca6d8264290dc	java_s1_1#1
d9a49bc2b1b0cdba4093d4ef5d276883a81a3141f05bdb46eb8bacb5b5d94acf	java_s1_1#1
feb14e2276d5b982e2f96fe7ac5372014b6d5d8a96182c0868a23eefebd914c7	java_s1_1#1
manifest_turnover.json	java_s1_1#1

ID	Title	Status	Stage ID
QLARIUS_CR_25	Access multiple databases	UNDER WORK	DEV
QLARIUS_CR_21	Support the Qlarius Financial rules engine	RAISED	DEV

---

## Installing and Licensing

The integration with Docker is installed and licensed separately from Dimensions CM. For details contact Serena Software.



## Chapter 2

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# Starting Docker

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# Starting a Docker Registry

**NOTE** If you are using Docker version 10, login to the registry using the Docker login command before performing any other registry operations.

To start a Dimensions CM Docker Registry run this command (parameters in square brackets are optional):

```
java -jar docker-registry.jar
--port=<port number>
--cm-url=scm:dimensions://<cm server>/<database>
--cm-product=<product>
--cm-stream=<product>:<stream>
--cm-part="<product>:<design part>"
[--cm-part-type=<type>]
[--cm-baseline-type=<type>]
[--cm-baseline-state=<state>]
[--work=<path>]
[--log-file=<path>]
[--manage-path=<path>]
[--manage-user=<user>]
[--manage-password=<password>]
[--ssl=false]
```

where:

- port=<port number>  
Specifies the port number of a Docker Registry.  
Default: 5000
- cm-url=scm:dimensions://<cm server>/<database>  
Specifies a CM server and database, for example:  
cm-url=scm:dimensions://mycmserver/cm\_typical@dim14
- cm-product=<product>  
Specifies a CM product for Docker Registry images, for example:  
cm-product=QLARIUS
- cm-stream=<product>:<stream>  
Specifies a CM stream where new images are delivered, for example:  
cm-stream=QLARIUS:DOCKER\_STREAM
- cm-part="<product>:<design part>"  
Specifies a design part that will own pushed images, for example:  
cm-part="QLARIUS:DOCKER\_IMAGES.A;1"
- cm-part-type  
Specifies the design part type for pushed images. Default: SUB-SYSTEM

- `cm-baseline-type=<type>`

Each time an image is pushed (delivered) to CM a new baseline is created. Use this parameter to specify a type, for example:

```
cm-baseline-type=MYTYPE
```

Default: BASELINE
- `cm-baseline-state=<state>`

Specifies the 'approved' state for baselines. Only images in 'approved' baselines can be searched and pulled. For example:

```
cm-baseline-state=APPROVED
```

Default: APPROVED
- `work=<path>`

By default Dimensions CM Docker Registry uses `C:\ProgramData\Docker\_work` to store temporary files when images are pushed and pulled. Use this parameter to specify a different location, for example:

```
work=/tmp/docker-registry
```
- `log-file=<path>`

By default Dimensions CM Docker Registry uses `C:\ProgramData\Serena\Docker\_logs\docker-registry.log` to store log files. Use this parameter to specify a different location, for example:

```
log-file=/tmp/Serena/Docker/_logs/docker-registry.log
```
- `manage-path=<path>`  
`manage-user=<user>`  
`manage-password=<password>`

By default Dimensions CM Docker Registry uses `/system` as the prefix for all diagnostic endpoints. The default user is `admin` and the default password is `secret`. You can specify your own path prefix and security credentials, for example:

```
manage-path=/manager
```

```
manage-user=superuser
```

```
manage-password=password
```
- `ssl=false`

Starts Dimensions CM Docker Registry without Secure Socket Layer (SSL) protection.

specifies the "type" of design part to create when a docker image is pushed into the registry. The default value for the parameter is "SUB-SYSTEM".

---

# Using a Docker Registry without SSL

Docker prefers registries to be protected with SSL. If you have a non-SSL registry you must tell Docker to make an exception and allow access.

- 1** Use Secure Shell (SSH) to log into the system running your Docker Engine. If you are using the Docker Toolbox on Windows this is a Virtual Image running under VirtualBox. You will need the IP address of that system to SSH into it. On Linux, SSH into the Linux system itself. If you are using the boot2docker image you can login as:
  - Username: docker
  - Password: tcuser
- 2** Edit the Docker profile and specify that the registry is insecure:

```
cd /var/lib/boot2docker
sudo sh
vi profile
```

At the top of this file EXTRA\_ARGS is defined. Add this line:

```
--insecure-registry=myregistryserver:5000
```
- 3** Change the host name and port number as needed and save the file.
- 4** Restart Docker:

```
/etc/init.d/docker restart
```
- 5** Log into a Dimensions CM Docker Registry:

```
docker login <myregistryserver>:<port number>
```
- 6** Enter Dimensions CM login credentials. If the login is successful you have configured Docker to use the non-SSL registry.

# Protecting a Docker Registry with SSL

This section is an example of how to SSL protect a Dimensions CM Docker Registry using a self-signed certificate.

## Creating a Certificate Authority

- 1 Use SSH to log into the boot2docker image (or the Linux system) that hosts your Docker engine.
- 2 Run `sudo sh` to change to a root shell.
- 3 Generate a Certificate Authority (CA) certificate and key pair (you can optionally change the password and subject):

```
cd /usr
mkdir ca_certs
chmod 700 ca_certs
cd ca_certs
mkdir certs private newcerts
echo 1000 > serial
touch index.txt
openssl req -new -x509 -days 3650 -extensions v3_ca \
    -keyout private/cakey.pem -out cacert.pem \
    -config /etc/ssl/openssl.cnf -passout pass:passwordformyca -subj \
    "/C=UK/ST=Surrey/L=Richmond/O=Acme/OU=Development/CN=Acme"
```

## Generating Certificates and Keys

Generate a certificate/key pair for the machine that will run your Dimensions CM Docker Registry and sign it with the CA you created in the previous step.

- 1 Use SSH to log into the boot2docker image (or any system where you are running the Docker Engine).
- 2 Run `sudo sh`
- 3 Run:

```
cd /usr
mkdir certs
openssl genrsa -out /usr/certs/domain.key 2048
openssl req -new -key /usr/certs/domain.key -out /usr/certs/ \
    domain.csr -subj "/C=UK/ST=Surrey/L=Richmond \
    /O=Acme/OU=Development/CN=<host running Docker Registry>"
openssl x509 -req -days 365 -in /usr/certs/domain.csr -signkey \
    /usr/certs/domain.key -out /usr/certs/domain.crt -CAkey /usr \
    ca_certs/private/cakey.pem -CA /usr/ca_certs/cacert.pem \
    -CAcreateserial -CAserial /usr/ca_certs/serial
```

---

where:

- `/usr/ca_certs/private/cakey.pem`  
Is the private key for the CA.
- `/usr/ca_certs/cacert.pem`  
Is the public certificate for the CA.
- `/usr/certs/domain.key`  
Is the private key for the registry server.
- `/usr/certs/domain.crt`  
Is the public certificate for the registry server.

## Trusting a Certificate Authority

Next you need to tell the Linux operating system inside the boot2docker image to trust the generated CA certificate. Usually Linux has scripts to do this but they are missing from the boot2docker Linux distribution so you need to do it manually.

Replace `4c05daf1` with whatever hash is returned by the `openssl x509 hash` command:

```
cp /usr/ca_certs/cacert.pem /usr/local/share/ca-certificates/yourca.pem
cd /etc/ssl/certs
ln -s /usr/local/share/ca-certificates/yourca.pem
openssl x509 -hash -in serenaca.pem
ln -s serenaca.pem 4c05daf1
```

## Configuring Docker to Trust a Registry

Every Docker Engine machine from which you want to access a remote Docker Registry requires a directory that matches your registry URL. Add your CA certificate and restart docker.

- 1 Use SSH to log into the boot2docker image on each remote host.
- 2 Run:  

```
mkdir -p /etc/docker/certs.d/myregistryserver:5000
cd /etc/docker/certs.d/myregistryserver:5000
```
- 3 Create a file called `ca.crt` containing the contents of the CA public certificate in:  
`/usr/ca_cert/cacert.pem`
- 4 Restart Docker:  

```
/etc/init.d/docker restart
```

## Creating a Keystore

- 1 Create a PKCS12 keystore that the Dimensions CM Docker Registry can use to identify itself:

```
openssl pkcs12 -export -in /usr/certs/domain.crt -inkey /usr/ \
certs/domain.key out /usr/certs/keystore.p12 -name \
tomcat -CAfile /usr/ca_certs/cacert.pem -caname root -chain
```

- 2 Copy the generated keystore.p12 file to the system running the Docker CM Registry JAR.

## Starting a Docker Registry in SSL Mode

Now that you have a SSL keystore, specify that it can be used when you start a Dimensions CM Docker Registry:

```
java -jar docker-registry.jar --port=5000 --ssl=true \
--keystore=C:\temp\keystore.p12 \
--keystore-type=PKCS12 \
--keystore-pass=changeit \
--cm-url=scm:dimensions://mycmserver/cm_typical@dim14 \
--cm-product=QLARIUS --cm-stream=QLARIUS:DOCKER_STREAM \
--cm-part=QLARIUS:DOCKER_IMAGES.A;1
```

Use the keystore password that you entered when you created the keystore.

## Logging in Securely to a Remote Docker Registry

Login securely to the remote Docker Registry:

```
docker login myregistryserver:5000
```

If the login is successful you have secured your Dimensions CM Docker Registry using SSL.





## Chapter 3

# Using Docker

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## Creating a Docker Image

- To create a Docker image:

```
docker build -t <image name> .
```

This is an example of how to build an image. Using Dimensions CM Docker Registry does not affect how you create images.

- You can optionally add a tag to identify an image:

```
docker build -t <image name>:<tag name> .
```

For example:

```
docker build -t myimage:turnover .
```

## Logging into a Dimensions CM Docker Registry

- 1 Run this command and specify the CM host machine and port number:

```
docker login <registry server>:<port>
```

For example:

```
docker login myregistryserver:5000
```

- 2 Enter credentials to log into CM.

## Pushing an Image

To push (deliver) an image to a Dimensions CM Docker Registry:

```
docker push <registry server>:<port>/<image name>:<tag>
```

For example:

```
docker push myregistryserver:5000/insurancesvc:turnover
```

### NOTE

- Docker image layers are delivered as items at the top of the stream (if they do not already exist).
- The item type and format used are determined by the CM upload rules. Check that you have an upload rule to handle files with no file extension.
- A new CM design part called <image name> is created, for example: INSURANCESVC  
The new part is created in a *product* and owned by a *parent design part*. The product and design part are configured by your administrator when the Docker Registry is started, see [page 10](#).
- The manifest of the image is created as an item owned by that design part.

- A new baseline is created from that design part containing the layers used by the image and the image manifest file:

```
<image name>-<tag>-<version>
```

For example:

```
INSURANCESVC-TURNOVER-1
```

- To save space in your repository, after you push an image:
  - Any layer that is no longer required is automatically deleted.
  - Only baselines that are at the *Approved* lifecycle state are preserved. All other baselines of the image are deleted.

## Approving an Image

Images are only visible to the user who created them. To make an image visible to all users:

- 1 Log into a CM client as the owner of the baseline associated with the image.
- 2 Action the baseline to the Approved lifecycle state (this state was configured when the Docker Registry started, see [page 10](#)).

### NOTE

- By default all images require approval though this can be switched off by a CM administrator when a Docker Registry is started.
- After an image is approved all users can search for and pull it, providing they have the required Dimensions CM privileges and roles.

## Searching for Images

- To list all images:

```
docker search <registry server>:5000/
```

Example output:

NAME	DESCRIPTION
hello-world	latest hello world image
insurancesvc	Docker image
ubuntu	Some Ubuntu image

This is a list of all the images that you created or approved.

- To search for images using a keyword:

```
docker search <registry server>:5000/ubun
```

Example output:

NAME	DESCRIPTION
ubuntu	Some Ubuntu image

---

## Pulling an Image

To pull a specific image tag:

```
docker pull <registry server>:5000/<image>:<tag>
```

For example:

```
docker pull myregistryserver:5000/insurancesvc:turnover
```

The pull command downloads the image from the corresponding baseline. All Dimensions CM privileges and roles are honored by the pull request.

## Specifying Change Requests

When you build or modify a Docker image you can specify Dimensions CM change requests using a LABEL called `com.serena.requests` inside your Docker file. For example if the Docker file contains:

```
FROM tomcat:8-jre8
LABEL com.serena.requests="QLARIUS_CR_21,QLARIUS_CR_25"
CMD ["catalina.sh", "run"]
```

when the image is pushed to the Dimensions CM Docker Registry, the resulting baseline is related to requests `QLARIUS_CR_21` and `QLARIUS_CR_25`.

## Chapter 4

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# Using the Example Docker Image

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---

## Overview

An example Docker image file is included with the Dimensions CM server installation and is placed in the same folder as the JAR file. The image is based on Alpine Linux (a compact Linux distribution ideal for containers) and includes:

- Oracle Java JDK 8
- The Dimensions CM Docker Registry JAR file
- A shell script to launch the registry

## Building the Example Image

To build the image go to the directory containing the Docker file and run Docker build, for example:

```
docker build -t cmregistry .
```

## Running the Example Image

### Supported Parameters

The command line parameters for the Dimensions CM Docker Registry are passed to the image as environment variables. The supported parameters are:

```
docker run -it
-e CM_URL=scm:dimensions:///<server>/<base database>@<db connection>
-e CM_PRODUCT=<product id>
-e CM_STREAM=<product id>:<stream id>
-e CM_PART=<full part specification>
[-e CM_PART_TYPE=<part type name>]
[-e CM_BASELINE_TYPE=<baseline type name>]
[-e CM_BASELINE_STATE=<approval state name>]
-p <port number>:5000
cmregistry
```

The registry always listens on port 5000. However, you can map this to a different port when running the image. For example, to listen on port 5555 specify the following:

```
-p 5555:5000
```

For an SSL protected registry you can also specify:

```
-e SSL=true
-e KEYSTORE=<path to PKCS12 keystore file>
-e KEYSTORE_PASS=<password for your keystore>
```

**NOTE** You may also need to mount a volume containing your keystore file:

```
-v /c/Users/myuser/certs:/certs
```

## Mandatory Parameters

You can run the registry with only the mandatory parameters, for example:

```
docker run -it
-e CM_URL=scm:dimensions://mycmserver/cm_typical@dim14 \
-e CM_PRODUCT=QLARIUS \
-e CM_STREAM=QLARIUS:DOCKER_IMAGES \
-e CM_PART="QLARIUS:DOCKER_IMAGES.A;1" \
-p 5000:5000 \
cmregistry
```

## Running the Image in SSL Mode

To run the image in Secure Socket Layer (SSL) mode, specify the SSL, KEYSTORE, and KEYSTORE\_PASS environment variables. For example:

```
docker run -it -v /c/Users/myuser/certs:/certs \
-e CM_URL=scm:dimensions://mycmserver/cm_typical@dim14 \
-e CM_PRODUCT=QLARIUS \
-e CM_STREAM=QLARIUS:DOCKER_IMAGES \
-e CM_PART="QLARIUS:DOCKER_IMAGES.A;1" \
-e SSL=true \
-e KEYSTORE=/certs/mykeystore.p12 \
-e KEYSTORE_PASS=changeit \
-p 5000:5000 \
cmregistry
```

**NOTE** For SSL mode mount a volume containing your keystore to the /certs mount point using the -v option. In the example above /c/Users/myuser/certs is mounted to /certs inside the container. That directory contains the mykeystore.p12 file containing certificates for the machine running the Docker engine.

Once the container is running, use it in the same way as when running the Dimensions CM Docker Registry JAR file. For details see [page 17](#).

