

Managing Multi-Container Applications Using docker-compose

WHAT?

docker-compose enables you to define and manage a multi-container application. The tool simplifies the deployment of such an application stack by using an easy-to-use definition file.

WHY?

The article describes how to create a multi-container application by using docker-compose.

EFFORT

It takes approx. 20 minutes to read the article.

GOAL

You will be able to create your own container-based application stack.

REQUIREMENTS

Application container images or the associated source files that are used to build the application.

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1 Tools involved in management of multi-container applications

`docker-compose` is the tool responsible for creating the multi-container application. By default, it uses Docker, which is not present on SUSE Linux Micro. To bypass Docker and use Podman instead, the `podman-docker` script is used. Therefore, you do not need to change your existing scripts from using Docker to Podman. The following sections provide detailed descriptions of the tools.

1.1 About Podman

Podman is a short name for Pod Manager Tool. It is a daemonless container engine that enables you to run and deploy applications using containers and container images. Podman provides a command-line interface to manage containers.

As Podman does not have a daemon, it provides integration with `systemd`. This makes it possible to control containers via `systemd` units. You can create these units for existing containers as well as generate units that can start containers if they do not exist in the system. Podman can run `systemd` inside containers.

Podman enables you to organize your containers into pods. Pods share the same network interface and resources. A typical use case for organizing a group of containers into a pod is a container that runs a database and a container with a client that accesses the database.

1.1.1 Installation of Podman

Podman is included in SUSE Linux Micro by default. However, if Podman is missing, you can install it as described below:

1. Run the command:

```
> sudo transactional-update pkg install podman
```

2. Restart your system to boot into the new snapshot.

1.2 About podman-docker

`podman-docker` is a bash script that changes any **docker** command you run into a corresponding **podman** command with the same passed arguments. Therefore, you can use all your Docker scripts without any modifications.

1.2.1 Installation of podman-docker

The `podman-docker` is not installed on SUSE Linux Micro by default. To install it, proceed as follows:

1. Install the package `podman-docker` by running:

```
transactional-update pkg install podman-docker
```

2. Reboot the system to switch to the latest snapshot.

1.3 About docker-compose

`docker-compose` is a tool for managing multi-container applications. `docker-compose` enables you to have multiple isolated environments on a single host, while it supports using variables between environments. Using `docker-compose`, you can recreate only those containers that have changed without destroying the whole multi-container application.



Important: **docker** replaced with the **podman** command

On SUSE Linux Micro, the `podman-docker` script is used to call Podman whenever you run `docker-compose`, as Docker is not present on SUSE Linux Micro by default.

1.3.1 Installing docker-compose

If `docker-compose` is not present on your system, you can install it by following the steps:

1. Run the command:

```
> sudo transactional-update pkg install docker-compose
```

2. After the installation is complete, reboot your system to boot into the new snapshot.

2 Creating a multi-container application

To create a multi-container application, proceed as follows:

1. Create the configuration file `compose.yml`. For details, refer to [Section 2.1, “Creating compose.yml”](#).
2. Prepare the required directory structure. We recommend placing the `compose.yml` file at the top of your working directory.
3. If needed, write your own container files specific to services used by the containerized application. For example, to deploy a Go application, create a container file for the Go application with the required configuration and dependencies.
We recommend creating a subdirectory per service in the working directory and placing the service-specific files there.
4. Deploy the multi-container application. For details, refer to [Section 2.2, “Deploying multi-container applications”](#).

2.1 Creating `compose.yml`

To create the multi-container application, you need to create a `compose.yml` file preferably placed in the working directory. It can be a single file, or you can use a more granular approach by utilizing fragments and extensions. Multiple docker-compose files can be also merged to define the whole application model.

The file `compose.yml` defines your application. You can include the following parts.

service

A service is a computing component of the application. For details regarding the definition, refer to [Section 2.1.1, “Services definition”](#).

networks

You can use the `network` statement to define custom networks and assign particular services to custom networks. For details, refer to [Section 2.1.2, “Networks definition”](#).

volumes

A directory managed by the container engine where services store and share data.

Environment variables

You may also need to use a list of environment variables that will be passed to your services. For details, refer to the [environment variables reference \(https://docs.docker.com/compose/environment-variables/\)](https://docs.docker.com/compose/environment-variables/).

configs

All configuration files required by the services must be declared in the `configs` section. For details, refer to the [configs definition \(https://docs.docker.com/compose/compose-file/08-configs/\)](https://docs.docker.com/compose/compose-file/08-configs/).

2.1.1 Services definition

When defining services, you either need to specify a container image to use, or provide source files to build the service from them.

To create the service container from an image, use the `image` statement:

```
services:
  db:
    image: database
```

Podman checks if the image name declared in the `compose.yml` file is available in the local container storage. If it is not, Podman pulls the image from one of the configured registries.

To build a service from source files, provide the source files and create a container file, both in the same directory. In the `compose.yml` file then use the `build` statement:

```
services:
  db:
    build: PATH_TO_SOURCE_FILES
```

If a particular service must be started after another, you can use the `depends_on` statement:

```
services:
  db:
    image: database
    depends_on:
      system:
        condition: SERVICE_CONDITION
```

The `SERVICE_CONDITION` can be one of the following: `service_started`, `service_healthy` or `service_completed_successfully`.

For more information regarding the `services` definition, refer to the [services specification \(https://docs.docker.com/compose/compose-file/05-services/\)](https://docs.docker.com/compose/compose-file/05-services/).

2.1.2 Networks definition

By default, docker-compose creates a default network, and each container in the application stack is included in the network. The default network does not have to be declared in the `compose.yml` file as docker-compose creates it automatically.

You can also define custom networks and assign particular services to them. For example, to create two networks, `network1` and `network2`, add the following snippet:

```
networks:
  network1:
    # Use a custom driver
    driver: custom-driver-1
  network2:
    # Use a custom driver and name the network
    driver: custom-driver-2
    name: custom_network
```

You can also use an existing network. In this case, mark the network as external:

```
networks:
  network1:
    name: network1
    external: true
```

For a complete `networks` specification, refer to the [networks specification \(https://docs.docker.com/compose/compose-file/06-networks/\)](https://docs.docker.com/compose/compose-file/06-networks/).

2.1.3 Example of `compose.yml`

The following example of `compose.yml` defines an application stack that uses the Prometheus monitoring system and the Grafana analytics system.

```
services:
  prometheus:
    image: prom/prometheus
    container_name: prometheus
```

```

command:
  - '--config.file=/etc/prometheus/prometheus.yml'
ports:
  - 9090:9090
restart: unless-stopped
volumes:
  - ./prometheus:/etc/prometheus
  - prom_data:/prometheus
grafana:
  image: grafana/grafana
  container_name: grafana
  ports:
    - 3000:3000
  restart: unless-stopped
  environment:
    - GF_SECURITY_ADMIN_USER=admin
    - GF_SECURITY_ADMIN_PASSWORD=grafana
  volumes:
    - ./grafana:/etc/grafana/provisioning/datasources
volumes:
  prom_data:

```

The project structure in this example must look as follows:

```

.
├── compose.yaml
├── grafana
│   └── datasource.yml
├── prometheus
│   └── prometheus.yml
└── README.md

```

2.2 Deploying multi-container applications

After you create the proper directory structure and the `compose.yml` file, you can deploy the multi-container application:

1. Verify that the container you intend to run doesn't already exist:

```
> podman ps --all
```

If needed, remove the particular container:

```
> podman rm -f CONTAINER_ID
```


2. Start the multi-container application by running the following command from the directory where `compose.yml` is located:

```
> docker compose up -d
```

`docker-compose` creates a separate network for the multi-container application.

3. You can verify that containers are running and ports are mapped by listing running containers:

```
> podman ps
```

3 Management of a multi-container application

After you create your multi-container application, you can use the `docker-compose` command to perform management operations. The command syntax is the following:

```
> docker compose [OPTIONS]
    COMMAND
```

Run the command from the same directory where the `compose.yml` file of the multi-container application you want to manage is located. Alternatively, provide a path to the `compose.yml` file using the `-f, --file` option. For example, to exit and remove the multi-container application:

```
> docker compose -f ./test/compose.yml down
```

Other useful commands:

images

To list all images used by the containers in the multi-container application.

```
> docker compose images
```

pause

To pause all containers.

```
> docker compose pause [SERVICE]
```

ps

To list containers in the multi-container application.

```
> docker compose ps
```

rm

To remove stopped containers.

```
> docker compose rm
```

start/stop

To start or stop containers.

```
> docker compose stop [SERVICE]
```

For a complete list of options and commands, run:

```
> docker-compose --help
```

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