



## **NVIDIA DOCA Developer Guide**

# Table of contents

1. Introduction

---

2. Developing Using BlueField Networking Platform

---

3. Developing Without BlueField Networking Platform

---

This guide details the recommended steps to set up an NVIDIA DOCA development environment.

# 1. Introduction

This guide is intended for software developers aiming to modify existing NVIDIA DOCA applications or develop their own DOCA-based software.

Instructions for installing DOCA on the NVIDIA® BlueField® Networking Platform (i.e., DPU or SuperNIC) can be found in the [NVIDIA DOCA Installation Guide for Linux](#).

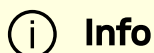
This guide focuses on the recommended flow for developing DOCA-based software, and will address the following scenarios:

- BlueField is accessible and can be used during the development and testing process
  - [Working within a development container](#)
- BlueField is inaccessible, and the development happens on the host or on a different server
  - [Working within a development container on top of QEMU running on the host](#)

It is recommended to follow the instructions for the first scenario, leveraging BlueField during the development and testing process.

This guide recommends using DOCA's development container during the development process on BlueField Platforms or on the host. Deploying development containers allows multiple developers to work simultaneously on the same device (host or BlueField Platform) in an isolated manner and even across multiple different DOCA SDK versions. This can allow multiple developers to work on the BlueField Platform itself, for example, without needing to have a dedicated BlueField per developer.

Another benefit of this container-based approach is that the development container allows developers to create and test their DOCA-based software in a user-friendly environment that comes pre-shipped with a set of handy development tools. The development container is focused on improving the development experience and is designed for that purpose, whereas the BlueField software is meant to be an efficient runtime environment for DOCA products.

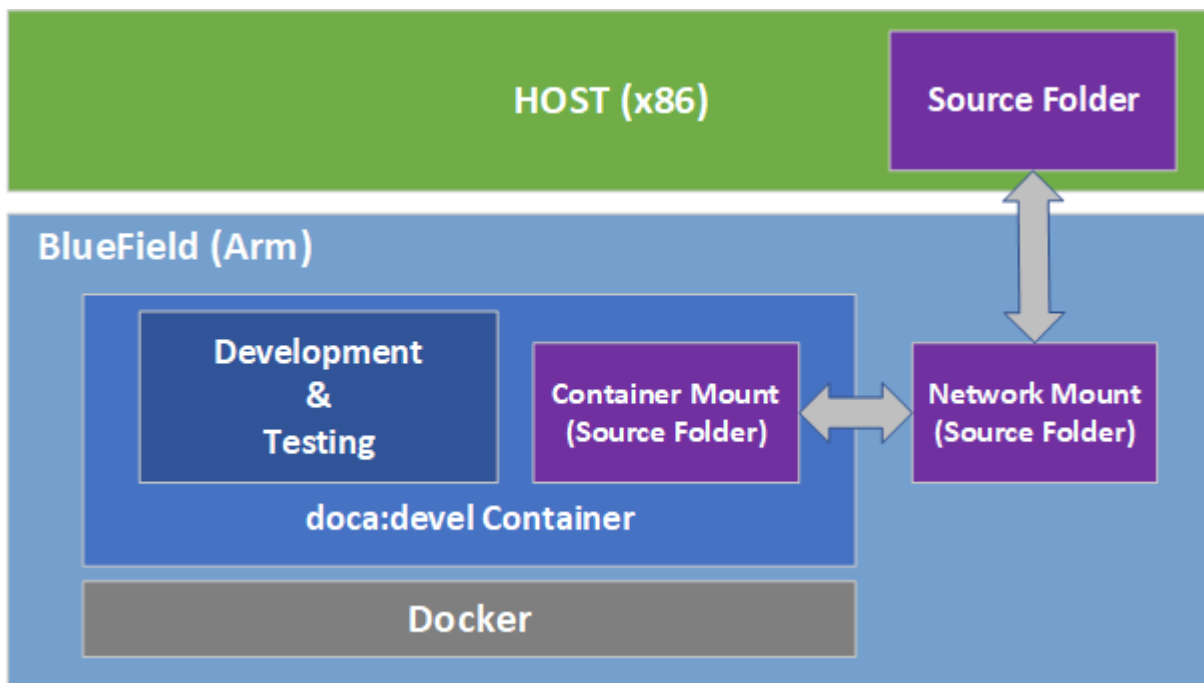


For questions, comments, and feedback, please contact us at [DOCA-Feedback@exchange.nvidia.com](mailto:DOCA-Feedback@exchange.nvidia.com).

## 2. Developing Using BlueField Networking Platform

### 2.1 Setup

DOCA's base image containers include a DOCA development container for the BlueField (`doca:devel`) which can be found on [NGC](#). It is recommended to deploy this container on top of BlueField when preparing a development setup.



The recommended approach for working using DOCA's development container on top of the BlueField, is by using [docker](#), which is already included in the supplied BFB image.

1. Make sure the docker service is started. Run:

```
sudo systemctl daemon-reload
sudo systemctl start docker
```

2. Pull the container image:

1. Visit the [NGC page](#) of the DOCA base image.
2. Under the "Tags" menu, select the desired development tag for BlueField.
3. The container tag for the docker `pull` command is copied to your clipboard once selected. Example docker `pull` command using the selected tag:

```
sudo docker pull nvcr.io/nvidia/doca/doca:1.5.1-devel
```

3. Once loaded locally, you may find the image's ID using the following command:

```
sudo docker images
```

Example output:

REPOSITORY		TAG	IMAGE ID	
CREATED	SIZE			
nvcr.io/nvidia/doca/doca		1.5.1-devel	931bd576eb49	10
months ago	1.49GB			

4. Run the docker image:

```
sudo docker run -v <source-code-folder>:/doca_devel -v  
/dev/hugepages:/dev/hugepages --privileged --net=host -it  
<image-name/ID>
```

For example, to map a source folder named `my_sources` into the same container tag from the example above, the command should look like this:

```
sudo docker run -v my_sources:/doca_devel -v  
/dev/hugepages:/dev/hugepages --privileged --net=host -it  
nvcr.io/nvidia/doca/doca:1.5.1-devel
```

After running the command, you get a shell inside the container where you can build your project using the regular build commands:

- From the container's perspective, the mounted folder will be named `/doca_devel`

### **Note**

Make sure to map a folder with write privileges to `everyone`. Otherwise, the docker would not be able to write the output files to it.

- `--net=host` ensures the container has network access, including visibility to SFs and VFs as allocated on BlueField
- `-v /dev/hugepages:/dev/hugepages` ensures that allocated huge pages are accessible to the container

## 2.2 Development

It is recommended to do the development within the `doca:devel` container. That said, some developers prefer different integrated development environments (IDEs) or development tools, and sometimes prefer working using a graphical IDE until it is time to compile the code. As such, the recommendation is to mount a network share to BlueField (refer to [NVIDIA DOCA DPU CLI](#) for more information) and to the container.

### **Note**

Having the same code folder accessible from the IDE and the container helps prevent edge cases where the compilation fails due to a typo in the code, but the typo is only fixed locally within the container and not propagated to the main source folder.

## 2.3 Testing

The container is marked as "privileged", hence it can directly access the hardware capabilities of the BlueField Platform. This means that once the tested program compiles successfully, it can be directly tested from within the container without the need to copy it to BlueField and running it there.

## 2.4 Publishing

Once the program passes the testing phase, it should be prepared for deployment. While some proof-of-concept (POC) programs are just copied "as-is" in their binary form, most deployments will probably be in the form of a package (`.deb` / `.rpm`) or a container.

Construction of the binary package can be done as-is inside the current `doca:devel` container, or as part of a CI pipeline that will leverage the same development container as part of it.

For the construction of a container to ship the developed software, it is recommended to use a multi-staged build that ships the software on top of the runtime-oriented DOCA base images:

- `doca:base-rt` – slim DOCA runtime environment
- `doca:full-rt` – full DOCA runtime environment similar to the BlueField image

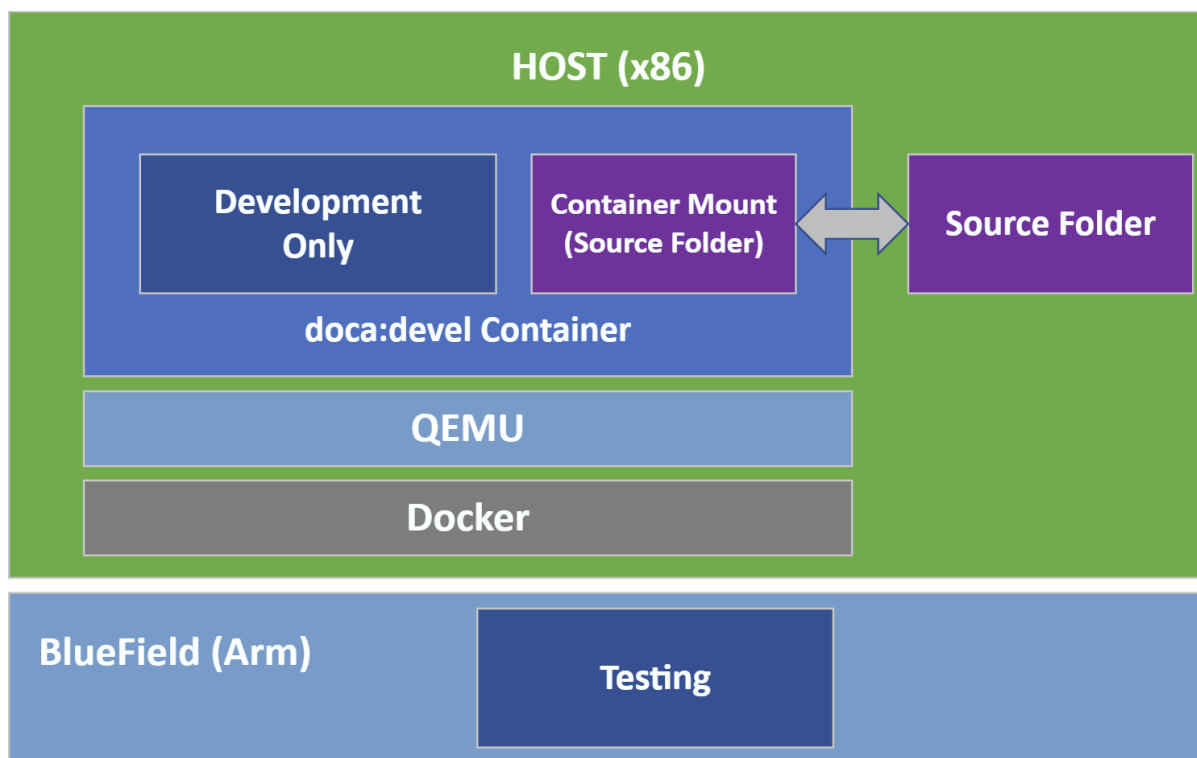
The runtime DOCA base images, alongside more details about their structure, can be found under the same NGC page that hosts the `doca:devel` image.

For a multi-staged build, it is recommended to compile the software inside the `doca:devel` container, and later copy it to one of the runtime container images. All

relevant images must be pulled directly from NGC (using `docker pull`) to the container registry of BlueField.

### 3. Developing Without BlueField Networking Platform

If the development process needs to be done without access to a BlueField Platform, the recommendation is to use a QEMU-based deployment of a container on top of a regular x86 server. The development container for the host will be the same `doca:devel` image we mentioned previously.



#### 3.1 Setup

1. Make sure Docker is installed on your host. Run:

```
docker version
```

If it is not installed, visit the official [Install Docker Engine](#) webpage for installation instructions.

## 2. Install QEMU on the host.

### **Note**

This step is for x86 hosts only. If you are working on an aarch64 host, move to the next step.

Host OS	Command
Ubuntu	<pre>sudo apt-get install qemu binfmt-support qemu-user-static sudo docker run --rm --privileged multiarch/qemu-user-static --reset -p yes</pre>
CentOS/RHEL 7.x	<pre>sudo yum install epel-release sudo yum install qemu-system-arm</pre>
CentOS 8.0/8.2	<pre>sudo yum install epel-release sudo yum install qemu-kvm</pre>
Fedora	<pre>sudo yum install qemu-system-aarch64</pre>

## 3. If you are using CentOS or Fedora on the host, verify if `qemu-aarch64.conf` Run:

```
cat /etc/binfmt.d/qemu-aarch64.conf
```

If it is missing, run:

```
echo ":qemu-  
aarch64:M::\x7fELF\x02\x01\x01\x00\x00\x00\x00\x00\x00\x00\x00  
aarch64-static:" > /etc/binfmt.d/qemu-aarch64.conf
```

4. If you are using CentOS or Fedora on the host, restart system binfmt. Run:

```
$ sudo systemctl restart systemd-binfmt
```

5. To load and execute the development container, refer to the "[Setup](#)" section discussing the same docker-based deployment on the BlueField side.

### **Note**

The `doca:devel` container supports multiple architectures. Therefore, Docker by default attempts to pull the one matching that of the current machine (i.e., `amd64` for the host and `arm64` for BlueField). Pulling the `arm64` container from the x86 host can be done by adding the flag `--platform=linux/arm64`:

```
sudo docker pull --platform=linux/arm64  
nvcr.io/nvidia/doca/doca:1.5.1-devel
```

## 3.2 Development

Much like the development phase [using BlueField](#), it is recommended to develop within the container running on top of QEMU.

### 3.3 Testing

While the compilation can be performed on top of the container, testing the compiled software must be done on top of a BlueField Platform. This is because the QEMU environment emulates an aarch64 architecture, but it does not emulate the hardware devices present on the BlueField Platform. Therefore, the tested program will not be able to access the devices needed for its successful execution, thus mandating that the testing is done on top of a physical BlueField.

#### **Note**

Make sure that the DOCA version used for compilation is the same as the version installed on BlueField used for testing.

### 3.4 Publishing

The publishing process is identical to the publishing process when using BlueField.

#### **Notice**

This document is provided for information purposes only and shall not be regarded as a warranty of a certain functionality, condition, or quality of a product. NVIDIA Corporation ("NVIDIA") makes no representations or warranties, expressed or implied, as to the accuracy or completeness of the information contained in this document and assumes no responsibility for any errors contained herein. NVIDIA shall have no liability for the consequences or use of such information or for any infringement of patents or other rights of third parties that may result from its use. This document is not a commitment to develop, release, or deliver any Material (defined below), code, or functionality.

NVIDIA reserves the right to make corrections, modifications, enhancements, improvements, and any other changes to this document, at any time without notice.

Customer should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

NVIDIA products are sold subject to the NVIDIA standard terms and conditions of sale supplied at the time of order acknowledgement, unless otherwise agreed in an individual sales agreement signed by authorized representatives of NVIDIA and customer ("Terms of Sale"). NVIDIA hereby expressly objects to applying any customer general terms and conditions with regards to the purchase of the NVIDIA product referenced in this document. No contractual obligations are formed either directly or indirectly by this document.

NVIDIA products are not designed, authorized, or warranted to be suitable for use in medical, military, aircraft, space, or life support equipment, nor in applications where failure or malfunction of the NVIDIA product can reasonably be expected to result in personal injury, death, or property or environmental damage. NVIDIA accepts no liability for inclusion and/or use of NVIDIA products in such equipment or applications and therefore such inclusion and/or use is at customer's own risk.

NVIDIA makes no representation or warranty that products based on this document will be suitable for any specified use. Testing of all parameters of each product is not necessarily performed by NVIDIA. It is customer's sole responsibility to evaluate and determine the applicability of any information contained in this document, ensure the product is suitable and fit for the application planned by customer, and perform the necessary testing for the application in order to avoid a default of the application or the product. Weaknesses in customer's product designs may affect the quality and reliability of the NVIDIA product and may result in additional or different conditions and/or requirements beyond those contained in this document. NVIDIA accepts no liability related to any default, damage, costs, or problem which may be based on or attributable to: (i) the use of the NVIDIA product in any manner that is contrary to this document or (ii) customer product designs.

No license, either expressed or implied, is granted under any NVIDIA patent right, copyright, or other NVIDIA intellectual property right under this document. Information published by NVIDIA regarding third-party products or services does not constitute a license from NVIDIA to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property rights of the third party, or a license from NVIDIA under the patents or other intellectual property rights of NVIDIA.

Reproduction of information in this document is permissible only if approved in advance by NVIDIA in writing, reproduced without alteration and in full compliance with all applicable export laws and regulations, and accompanied by all associated conditions, limitations, and notices.

THIS DOCUMENT AND ALL NVIDIA DESIGN SPECIFICATIONS, REFERENCE BOARDS, FILES, DRAWINGS, DIAGNOSTICS, LISTS, AND OTHER DOCUMENTS (TOGETHER AND SEPARATELY, "MATERIALS") ARE BEING PROVIDED "AS IS." NVIDIA MAKES NO WARRANTIES, EXPRESSED, IMPLIED, STATUTORY, OR OTHERWISE WITH RESPECT TO THE MATERIALS, AND EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. TO THE EXTENT NOT PROHIBITED BY LAW, IN NO EVENT WILL NVIDIA BE LIABLE FOR ANY DAMAGES, INCLUDING WITHOUT LIMITATION ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE, OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED AND REGARDLESS OF THE THEORY OF LIABILITY, ARISING OUT OF ANY USE OF THIS DOCUMENT, EVEN IF NVIDIA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Notwithstanding any damages that customer might incur for any reason whatsoever, NVIDIA's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms of Sale for the product.

## **Trademarks**

NVIDIA and the NVIDIA logo are trademarks and/or registered trademarks of NVIDIA Corporation in the U.S. and other countries. Other company and product names may be trademarks of the respective companies with which they are associated.

© Copyright 2025, NVIDIA. PDF Generated on 10/09/2025