NVIDIA BlueField DPU Modes of Operation

User Guide

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Table of Contents

Chapter 1. Introduction

The NVIDIA® BlueField® DPU has several modes of operation:

- DPU mode, or embedded function (ECPF) ownership, where the embedded Arm system controls the NIC's resources and data path (default)
- Zero-trust DPU mode which is an extension of the ECPF ownership with additional restrictions on the host side
- NIC mode where the DPU behaves exactly like an adapter card from the perspective of the external host

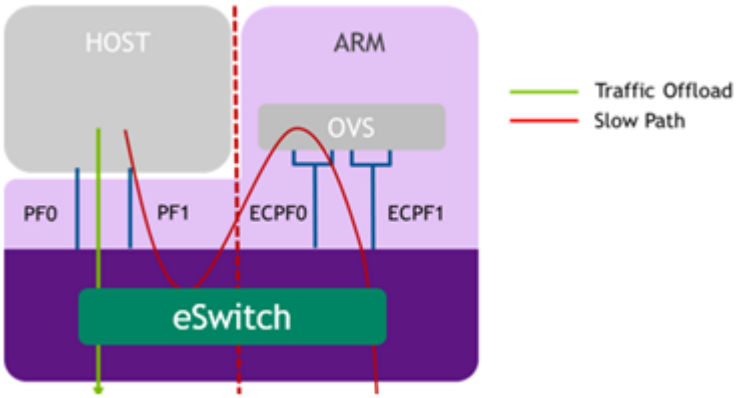
Chapter 2. DPU Mode

This mode, also known as ECPF or embedded mode, is the default mode for the BlueField DPU.

In DPU mode, the NIC resources and functionality are owned and controlled by the embedded Arm subsystem. All network communication to the host flows through a virtual switch control plane hosted on the Arm cores, and only then proceeds to the host. While working in this mode, the DPU is the trusted function managed by the data center and host administrator—to load network drivers, reset an interface, bring an interface up and down, update the firmware, and change the mode of operation on the DPU device.

A network function is still exposed to the host, but it has limited privileges. In particular:

1. The driver on the host side can only be loaded after the driver on the embedded side has loaded and completed NIC configuration.
2. All ICM (interface configuration memory) is allocated by the ECPF and resides in the embedded host memory.
3. The ECPF controls and configures the NIC embedded switch which means that traffic to and from the host interface always lands on the Arm side.



When the server and DPU are initiated, the networking to the host is blocked until the virtual switch on the DPU is loaded. Once it is loaded, traffic to the host is allowed by default.

There are two ways to pass traffic to the host interface: Either using representors to forward traffic to the host (every packet to/from the host would be handled also by the

network interface on the embedded Arm side), or push rules to the embedded switch which allows and offloads this traffic.

Chapter 3. Zero-trust DPU Mode

Zero-trust mode is a specialization of DPU mode which implements an additional layer of security where the host system administrator is prevented from accessing the DPU from the host. Once zero-trust mode is enabled, the data center administrator should control the DPU entirely though the Arm cores and/or BMC connection instead of through the host.

For security and isolation purposes, it is possible to restrict the host from performing operations that can compromise the DPU. The following operations can be restricted individually when changing the DPU host to zero-trust mode:

- Port ownership – the host cannot assign itself as port owner
- Hardware counters – the host does not have access to hardware counters
- Tracer functionality is blocked
- RShim interface is blocked
- Firmware flash is restricted

To enable host restriction:

1. Start the MST service.
   ```
   $ mst start
   ```
2. Set zero-trust mode. From the Arm side, run:
   ```
   $ mlxprivhost -d /dev/mst/<device> r --disable_rshim --disable_tracer --
   disable_counter_rd --disable_port_owner
   ```

   Note: If RShim is disabled, power cycle is required.

   Note: Power cycle is required if any `--disable_*` flags are used.

To disable host restriction and set the mode to privileged, run:

```
$ mlxprivhost -d /dev/mst/<device> p
```

The configuration takes effect immediately.

Note: If you are reverting from `rshim-disabled` mode, system power cycle is required.

Note: Power cycle is required when reverting to privileged mode if host restriction has been applied using any `--disable_*` flags.

Chapter 4. NIC Mode

Note: Prior to configuring NIC mode, refer to known issue #3048250 in the NVIDIA DOCA Release Notes.

Note: When NIC mode is enabled, the drivers and services on the Arm are no longer functional.

In this mode, the DPU behaves exactly like an adapter card from the perspective of the external host. The ECPFs on the Arm side are not functional in this mode but the user is still able to access the Arm system and update `mlxconfig` options.

To enable DPU NIC mode, run the following from the x86 host side:

```
$ mst start
$ mlxconfig -d /dev/mst/<device> s INTERNAL_CPU_MODEL=1 \
INTERNAL_CPU_PAGE_SUPPLIER=1 \
INTERNAL_CPU_ESWITCH_MANAGER=1 \
INTERNAL_CPU_IB_VPORT0=1 \
INTERNAL_CPU_OFFLOAD_ENGINE=1
$ mlxfwreset -d /dev/mst/<device> r
Minimal reset level for device, /dev/mst/mt41686_pciconf0:

3: Driver restart and PCI reset
Continue with reset?[y/N] y
-I- Sending Reset Command To Fw             -Done
-I- Stopping Driver                         -Done
-I- Resetting PCI                           -Done
-I- Starting Driver                         -Done
-I- Restarting MST                          -Done
-I- FW was loaded successfully.
```

Note: To restrict RShim PF (optional), make sure to configure `INTERNAL_CPU_RSHIM=1` as part of the `mlxconfig` command.

Note: Multi-host is not supported when the DPU is operating in NIC mode.

Note: To obtain firmware BINs for NVIDIA® BlueField®-2 devices, refer to the BlueField-2 firmware download page.

Note: If RShim is disabled, then power cycle is mandatory.

To change from NIC mode back to DPU (ECPF) mode:

1. Install and start the RShim driver on the host.
2. Disable NIC mode. Run:

```
$ mst start
$ mlxconfig -d /dev/mst/<device> s INTERNAL_CPU_MODEL=1 \
INTERNAL_CPU_PAGE_SUPPLIER=0 \
INTERNAL_CPU_ESWITCH_MANAGER=0 \
INTERNAL_CPU_IB_VPORT0=0 \
INTERNAL_CPU_OFFLOAD_ENGINE=0
$ mlxfwreset -d /dev/mst/<device> r
```

Note: If `INTERNAL_CPU_RSHIM=1`, then make sure to configure `INTERNAL_CPU_RSHIM=0` as part of the `mlxconfig` command.

Note: If RShim is enabled, then power cycle is mandatory.

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