



Host-side Interface Configuration

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The NVIDIA® BlueField® DPU registers on the host OS a "DMA controller" for DPU management over PCIe. This can be verified by running the following:

```
# lspci -d 15b3: | grep 'SoC Management Interface'  
27:00.2 DMA controller: Mellanox Technologies MT42822 BlueField-2  
SoC Management Interface (rev 01)
```

A special driver called RShim must be installed and run to expose the various BlueField management interfaces on the host OS. Refer to section "[Install RShim on Host](#)" for information on how to obtain and install the host-side RShim driver.

When the RShim driver runs properly on the host side, a sysfs device, `/dev/rshim0/*`, and a virtual Ethernet interface, `tmfifo_net0`, become available. The following is an example for querying the status of the RShim driver on the host side:

```

# systemctl status rshim
rshim.service - rshim driver for BlueField SoC
   Loaded: loaded (/lib/systemd/system/rshim.service; disabled;
vendor preset: enabled)
   Active: active (running) since Tue 2022-05-31 14:57:07 IDT;
1 day 1h ago
     Docs: man:rshim(8)
  Process: 90322 ExecStart=/usr/sbin/rshim $OPTIONS
(code=exited, status=0/SUCCESS)
 Main PID: 90323 (rshim)
    Tasks: 11 (limit: 76853)
   Memory: 3.3M
    CGroup: /system.slice/rshim.service
           90323 /usr/sbin/rshim
May 31 14:57:07 ... systemd[1]: Starting rshim driver for
BlueField SoC...
May 31 14:57:07 ... systemd[1]: Started rshim driver for BlueField
SoC.
May 31 14:57:07 ... rshim[90323]: Probing pcie-0000:a3:00.2(vfio)
May 31 14:57:07 ... rshim[90323]: Create rshim pcie-0000:a3:00.2
May 31 14:57:07 ... rshim[90323]: rshim pcie-0000:a3:00.2 enable
May 31 14:57:08 ... rshim[90323]: rshim0 attached

```

Virtual Ethernet Interface

On the host, the RShim driver exposes a virtual Ethernet device called `tmfifo_net0`. This virtual Ethernet can be thought of as a peer-to-peer tunnel connection between the host and the DPU OS. The DPU OS also configures a similar device. The DPU OS's BFB images are customized to configure the DPU side of this connection with a preset IP of 192.168.100.2/30. It is up to the user to configure the host side of this connection. Configuration procedures vary for different OSs.

The following example configures the host side of `tmfifo_net0` with a static IP and enables IPv4-based communication to the DPU OS:

```
# ip addr add dev tmfifo_net0 192.168.100.1/30
```

i Note

For instructions on persistent IP configuration of the `tmfifo_net0` interface, refer to step "Assign a static IP to `tmfifo_net0`" under "[Updating Repo Package on Host Side](#)".

Logging in from the host to the DPU OS is now possible over the virtual Ethernet. For example:

```
ssh ubuntu@192.168.100.2
```

RShim Support for Multiple DPUs

Multiple DPUs may connect to the same host machine. When the RShim driver is loaded and operating correctly, each board is expected to have its own device directory on `sysfs`, `/dev/rshim<N>`, and a virtual Ethernet device, `tmfifo_net<N>`.

The following are some guidelines on how to set up the RShim virtual Ethernet interfaces properly if multiple DPUs are installed in the host system.

There are two methods to manage multiple `tmfifo_net` interfaces on a Linux platform:

- Using a bridge, with all `tmfifo_net<N>` interfaces on the bridge – the bridge device bears a single IP address on the host while each DPU has unique IP in the same subnet as the bridge
- Directly over the individual `tmfifo_net<N>` – each interface has a unique subnet IP and each DPU has a corresponding IP per subnet

Whichever method is selected, the host-side `tmfifo_net` interfaces should have different MAC addresses, which can be:

- Configured using `ifconfig`. For example:

```
$ ifconfig tmfifo_net0 192.168.100.1/24 hw ether
02:02:02:02:02:02
```

- Or saved in configuration via the `/udev/rules` as can be seen later in this section.

In addition, each Arm-side `tmfifo_net` interface must have a unique MAC and IP address configuration, as BlueField OS comes uniformly pre-configured with a generic MAC, and 192.168.100.2. The latter must be configured in each DPU manually or by DPU customization scripts during BlueField OS installation.

Multi-board Management Example

This example deals with two BlueField DPUs installed on the same server (the process is similar for more DPUs).

This example assumes that the RShim package has been installed on the host server.

Configuring Management Interface on Host

Note

This example is relevant for CentOS/RHEL operating systems only.

1. Create a `bf_tmfifo` interface under `/etc/sysconfig/network-scripts`. Run:

```
vim /etc/sysconfig/network-scripts/ifcfg-br_tmfifo
```

2. Inside `ifcfg-br_tmfifo`, insert the following content:

```
DEVICE="br_tmfifo"  
BOOTPROTO="static"  
IPADDR="192.168.100.1"  
NETMASK="255.255.255.0"  
ONBOOT="yes"  
TYPE="Bridge"
```

3. Create a configuration file for the first BlueField DPU, `tmfifo_net0`. Run:

```
vim /etc/sysconfig/network-scripts/ifcfg-tmfifo_net0
```

4. Inside `ifcfg-tmfifo_net0`, insert the following content:

```
DEVICE=tmfifo_net0  
BOOTPROTO=none  
ONBOOT=yes  
NM_CONTROLLED=no  
BRIDGE=br_tmfifo
```

5. Create a configuration file for the second BlueField DPU, `tmfifo_net1`. Run:

```
DEVICE=tmfifo_net1  
BOOTPROTO=none  
ONBOOT=yes  
NM_CONTROLLED=no  
BRIDGE=br_tmfifo
```

6. Create the rules for the `tmfifo_net` interfaces. Run:

```
vim /etc/udev/rules.d/91-tmfifo_net.rules
```

7. Restart the network for the changes to take effect. Run:

```
# /etc/init.d/network restart
Restarting network (via systemctl):          [ OK ]
```

Configuring BlueField DPU Side

BlueField DPUs arrive with the following factory default configurations for `tmfifo_net0`.

Address	Value
MAC	00:1a:ca:ff:ff:01
IP	192.168.100.2

Therefore, if you are working with more than one DPU, you must change the default MAC and IP addresses.

Updating RShim Network MAC Address

Note

This procedure is relevant for Ubuntu/Debian (`sudo` needed), and CentOS BFBs. The procedure only affects the `tmfifo_net0` on the Arm side.

1. Use a Linux console application (e.g. `screen` or `minicom`) to log into each BlueField. For example:

```
# sudo screen /dev/rshim<0|1>/console 115200
```

2. Create a configuration file for `tmfifo_net0` MAC address. Run:

```
# sudo vi /etc/bf.cfg
```

3. Inside `bf.cfg`, insert the new MAC:

```
NET_RSHIM_MAC=00:1a:ca:ff:ff:03
```

4. Apply the new MAC address. Run:

```
sudo bfcfg
```

5. Repeat this procedure for the second BlueField DPU (using a different MAC address).

Info

Arm must be rebooted for this configuration to take effect. It is recommended to update the IP address before you do that to avoid unnecessary reboots.

Updating IP Address

For Ubuntu:

1. Access the file `50-cloud-init.yaml` and modify the `tmfifo_net0` IP address:

```
sudo vim /etc/netplan/50-cloud-init.yaml

        tmfifo_net0:
            addresses:
                - 192.168.100.2/30    ===>>>
192.168.100.3/30
```

2. Reboot the Arm. Run:

```
sudo reboot
```

3. Repeat this procedure for the second BlueField DPU (using a different IP address).

Info

Arm must be rebooted for this configuration to take effect. It is recommended to update the MAC address before you do that to avoid unnecessary reboots.

For CentOS:

1. Access the file `ifcfg-tmfifo_net0`. Run:

```
# vim /etc/sysconfig/network-scripts/ifcfg-tmfifo_net0
```

2. Modify the value for `IPADDR`:

```
IPADDR=192.168.100.3
```

3. Reboot the Arm. Run:

```
reboot
```

Or perform `netplan apply`.

4. Repeat this procedure for the second BlueField DPU (using a different IP address).

Info

Arm must be rebooted for this configuration to take effect. It is recommended to update the MAC address before you do that to avoid unnecessary reboots.

Permanently Changing Arm-side MAC Address

Note

It is assumed that the commands in this section are executed with root (or `sudo`) permission.

The default MAC address is `00:1a:ca:ff:ff:01`. It can be changed using `ifconfig` or by updating the UEFI variable as follows:

1. Log into Linux from the Arm console.

2. Run:

```
$ "ls /sys/firmware/efi/efivars".
```

3. If not mounted, run:

```
$ mount -t efivarfs none /sys/firmware/efi/efivars
$ chattr -i /sys/firmware/efi/efivars/RshimMacAddr-8be4df61-
93ca-11d2-aa0d-00e098032b8c
$ printf "\x07\x00\x00\x00\x00\x1a\xca\xff\xff\x03" > \
  /sys/firmware/efi/efivars/RshimMacAddr-8be4df61-93ca-11d2-
aa0d-00e098032b8c
```

The `printf` command sets the MAC address to `00:1a:ca:ff:ff:03` (the last six bytes of the `printf` value). Either reboot the device or reload the `tmfifo` driver for the change to take effect.

The MAC address can also be updated from the server host side while the Arm-side Linux is running:

1. Enable the configuration. Run:

```
# echo "DISPLAY_LEVEL 1" > /dev/rshim0/misc
```

2. Display the current setting. Run:

```
# cat /dev/rshim0/misc
DISPLAY_LEVEL  1 (0:basic, 1:advanced, 2:log)
BOOT_MODE      1 (0:rshim, 1:emmc, 2:emmc-boot-swap)
BOOT_TIMEOUT   300 (seconds)
DROP_MODE      0 (0:normal, 1:drop)
SW_RESET       0 (1: reset)
DEV_NAME       pcie-0000:04:00.2
DEV_INFO       BlueField-2(Rev 1)
PEER_MAC       00:1a:ca:ff:ff:01 (rw)
PXE_ID         0x00000000 (rw)
VLAN_ID        0 0 (rw)
```

3. Modify the MAC address. Run:

```
$ echo "PEER_MAC  xx:xx:xx:xx:xx:xx" > /dev/rshim0/misc
```

OOB Ethernet Interface

The OOB interface is a gigabit Ethernet interface which provides TCP/IP network connectivity to the Arm cores. This interface is named `oob_net0` and is intended to be used for management traffic (e.g. file transfer protocols, SSH, etc). The Linux driver that controls this interface is named `mlxbf_gige.ko`, and is automatically loaded upon boot. This interface can be configured and monitored by use of standard tools (e.g. `ifconfig`, `ethtool`, etc). The OOB interface is subject to the following design limitations:

- Only supports 1Gb/s full-duplex setting
- Only supports GMII access to external PHY device
- Supports maximum packet size of 2KB (i.e. no support for jumbo frames)

The OOB interface can also be used for PXE boot. This OOB port is not a path for the boot stream. Any attempt to push a BFB to this port will not work.

OOB Interface MAC Address

The MAC address to be used for the OOB port is burned into Arm-accessible UPVS EEPROM during the manufacturing process. This EEPROM device is different from the SPI Flash storage device used for the NIC firmware and associated NIC MACs/GUIDs. The value of the OOB MAC address is specific to each platform and is visible on the board-level sticker.

Warning

It is not recommended to reconfigure the MAC address from the MAC configured during manufacturing.

If there is a need to re-configure this MAC for any reason, follow these steps to configure a UEFI variable to hold new value for OOB MAC.:

Note

The creation of an OOB MAC address UEFI variable will override the OOB MAC address defined in EEPROM, but the change can be reverted.

1. Log into Linux from the Arm console.
2. Issue the command `ls /sys/firmware/efi/efivars` to show whether efivarfs is mounted. If it is not mounted, run:

```
mount -t efivarfs none /sys/firmware/efi/efivars
```

3. Run:

```
chattr -i /sys/firmware/efi/efivars/OobMacAddr-8be4df61-93ca-11d2-aa0d-00e098032b8c
```

4. Set the MAC address to 00:1a:ca:ff:ff:03 (the last six bytes of the printf value).

```
printf "\x07\x00\x00\x00\x00\x1a\xca\xff\xff\x03" >  
/sys/firmware/efi/efivars/OobMacAddr-8be4df61-93ca-11d2-aa0d-00e098032b8c
```

5. Reboot the device for the change to take effect.

To revert this change and go back to using the MAC as programmed during manufacturing, follow these steps:

1. Log into UEFI from the Arm console, go to "Boot Manager" then "EFI Internal Shell".
2. Delete the OOB MAC UEFI variable. Run:

```
dmpstore -d OobMacAddr
```

3. Reboot the device by running "reset" from UEFI.
4. Log into Linux from the Arm console.
5. Issue the command `ls /sys/firmware/efi/efivars` to show whether efivarfs is mounted. If it is not mounted, run:

```
mount -t efivarfs none /sys/firmware/efi/efivars
```

6. Run:

```
chattr -i /sys/firmware/efi/efivars/OobMacAddr-8be4df61-93ca-11d2-aa0d-00e098032b8c
```

7. Reconfigure the original MAC address burned by the manufacturer in the format `aa\bb\cc\dd\ee\ff`. Run:

```
printf "\x07\x00\x00\x00\x00\<original-MAC-address>" >  
/sys/firmware/efi/efivars/OobMacAddr-8be4df61-93ca-11d2-aa0d-00e098032b8c
```

8. Reboot the device for the change to take effect.

Supported ethtool Options for OOB Interface

The Linux driver for the OOB port supports the handling of some basic ethtool requests: get driver info, get/set ring parameters, get registers, and get statistics.

To use the ethtool options available, use the following format:

```
$ ethtool [<option>] <interface>
```

Where `<option>` may be:

- `<no-argument>` – display interface link information
- `-i` – display driver general information
- `-S` – display driver statistics
- `-d` – dump driver register set

- `-g` – display driver ring information
- `-G` – configure driver ring(s)
- `-k` – display driver offload information
- `-a` – query the specified Ethernet device for pause parameter information
- `-r` – restart auto-negotiation on the specified Ethernet device if auto-negotiation is enabled

For example:

```
$ ethtool oob_net0
Settings for oob_net0:
    Supported ports: [ TP ]
    Supported link modes:   1000baseT/Full
    Supported pause frame use: Symmetric
    Supports auto-negotiation: Yes
    Supported FEC modes: Not reported
    Advertised link modes:  1000baseT/Full
    Advertised pause frame use: Symmetric
    Advertised auto-negotiation: Yes
    Advertised FEC modes: Not reported
    Link partner advertised link modes: 1000baseT/Full
    Link partner advertised pause frame use: Symmetric
    Link partner advertised auto-negotiation: Yes
    Link partner advertised FEC modes: Not reported
    Speed: 1000Mb/s
    Duplex: Full
    Port: Twisted Pair
    PHYAD: 3
    Transceiver: internal
    Auto-negotiation: on
    MDI-X: Unknown
    Link detected: yes
```

```
$ ethtool -i oob_net0
driver: mlxbf_gige
version:
firmware-version:
expansion-rom-version:
bus-info: MLNXBF17:00
supports-statistics: yes
supports-test: no
supports-eeprom-access: no
supports-register-dump: yes
supports-priv-flags: no
```

```
# Display statistics specific to BlueField-2 design (i.e.
statistics that are not shown in the output of "ifconfig
oob0_net")
```

```
$ ethtool -S oob_net0
NIC statistics:
  hw_access_errors: 0
  tx_invalid_checksums: 0
  tx_small_frames: 1
  tx_index_errors: 0
  sw_config_errors: 0
  sw_access_errors: 0
  rx_truncate_errors: 0
  rx_mac_errors: 0
  rx_din_dropped_pkts: 0
  tx_fifo_full: 0
  rx_filter_passed_pkts: 5549
  rx_filter_discard_pkts: 4
```

IP Address Configuration for OOB Interface

The files that control IP interface configuration are specific to the Linux distribution. The udev rules file (`/etc/udev/rules.d/92-oob_net.rules`) that renames the OOB interface to `oob_net0` and is the same for Yocto, CentOS, and Ubuntu:

```
SUBSYSTEM=="net", ACTION=="add",  
DEVPATH=="/devices/platform/MLNXBF17:00/net/eth[0-9]",  
NAME="oob_net0"
```

The files that control IP interface configuration are slightly different for CentOS and Ubuntu:

- CentOS configuration of IP interface:
 - Configuration file for `oob_net0`:
`/etc/sysconfig/network-scripts/ifcfg-oob_net0`
 - For example, use the following to enable DHCP:

```
NAME="oob_net0"  
DEVICE="oob_net0"  
NM_CONTROLLED="yes"  
PEERDNS="yes"  
ONBOOT="yes"  
BOOTPROTO="dhcp"  
TYPE=Ethernet
```

- For example, to configure static IP use the following:

```
NAME="oob_net0"  
DEVICE="oob_net0"  
IPV6INIT="no"  
NM_CONTROLLED="no"  
PEERDNS="yes"  
ONBOOT="yes"  
BOOTPROTO="static"  
IPADDR="192.168.200.2"  
PREFIX=30  
GATEWAY="192.168.200.1"  
DNS1="192.168.200.1"  
TYPE=Ethernet
```

- For Ubuntu configuration of IP interface, refer to section "[Default Network Interface Configuration](#)".

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