



**NVIDIA BlueField DPU BSP v4.7.0**

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# About This Document

NVIDIA® BlueField® DPU software is built from the BlueField BSP (Board Support Package) which includes the operating system and the DOCA framework. BlueField BSP includes the bootloaders and other essentials for loading and setting software components. The BSP loads the official BlueField operating system (Ubuntu reference Linux distribution) to the DPU. DOCA is the software framework and SDK for the development of applications and infrastructure services. DOCA includes runtime libraries; the DOCA Runtime stack for Arm supports various accelerations for storage, networking, and security. As such, customers can run any Linux-based application in the BlueField software environment seamlessly.

This guide provides product release notes as well as information on the BSP and how to develop and/or customize applications, system software, and file system images for the BlueField platform.

## Info

**Important:** Make sure to download the latest available software packages for the procedures documented in this guide to run as expected.

# Intended Audience

This document is intended for software developers and DevOps engineers interested in creating and/or customizing software applications and system software for the NVIDIA BlueField DPU platform.

# Software Download

To download product software, refer to the [DOCA SDK](#) developer zone.

## Technical Support

 **Note**

For BlueField-3, a firmware version of 32.38.1002 or greater requires a BFB version of 2.2.0 or higher. Downgrading to lower BFB/firmware versions may result in anomalous behavior.

 **Note**

Make sure to perform a [graceful shutdown](#) of the Arm OS in advance of performing system/host power cycle when required by the manual.

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- E-mail: [enterprisesupport@nvidia.com](mailto:enterprisesupport@nvidia.com)
- Enterprise Support page: <https://www.nvidia.com/en-us/support/enterprise>

Customers who purchased NVIDIA M-1 Global Support Services, please see your contract for details regarding technical support.

Customers who purchased NVIDIA products through an NVIDIA-approved reseller should first seek assistance through their reseller.

# Glossary

Term	Description
ACE	AXI coherency extensions
ACPI	Advanced configuration and power interface
AMBA®	Advanced microcontroller bus architecture
ARB	Arbitrate
ATF	Arm-trusted firmware
AXI4	Advanced eXtensible Interface 4
BDF address	Bus, device, function address. This is the device's PCIe bus address to uniquely identify the specific device.
BERT	Boot error record table
BF_INST_DIR	The directory where the BlueField software is installed
BFB	BlueField bootstream
BMC	Board management controller
BSD	BlueField software distribution
BSP	BlueField support package
BUF	Buffer
CBS	Committed burst size
CHI	Coherent hub interface; Arm® protocol used over the BlueField Skymesh specification
CIR	Committed information rate
CL	Cache line
CMDQ	Command queue
CMO	Cache maintenance operation

<b>Term</b>	<b>Description</b>
COB	Collision buffer
DAT	Data
DEK	Data encryption key
DMA	Direct memory access
DOCA	DPU SDK
DOT	Device ownership transfer
DPA	Data path accelerator; a n auxiliary processor designed to accelerate data-path operations
DPDK	Data plane development kit
DPI	Deep packet inspection
DPU	Data processing unit, the third pillar of the data center with CPU and GPU
DVM	Distributed virtual memory
DW	Dword
EBS	Excess burst size
ECPF	Embedded CPU physical function
EIR	Excess information rate
EMEM/E MI	External memory interface; block in the MSS which performs the actual read/write from the DDR device
eMMC	Embedded multi-media card
ESP	EFI system partition
ESP header	Encapsulating security payload
EU	Execution unit. HW thread; a logical DPA processing unit.
FIPS	Federal Information Processing Standards
FPGA	Field-programmable gate arrays
FS	File system
FW	Firmware

<b>Term</b>	<b>Description</b>
GDB	GNU debugger
GPT	GUID partition table
HCA	Host-channel adapter
HNF	Home node interface
Host	<p>When referring to "the host" this documentation is referring to the <b>server host</b>. When referring to the Arm based host, the documentation will specifically call out "Arm host".</p> <ul style="list-style-type: none"> <li>• Server host OS refers to the Host Server OS (Linux or Windows)</li> <li>• Arm host refers to the AARCH64 Linux OS which is running on the BlueField Arm Cores</li> </ul>
HW	Hardware
hwmon	Hardware monitoring
IB	InfiniBand
ICM	Interface configuration memory
IKE	Internet key exchange
IPMB	Intelligent platform management bus
IPMI	Intelligent platform management interface
IR	Intermediate representation
KGDB	Kernel debugger
KGDBOC	Kernel debugger over console
LAT	Latency
LCRD	Link credit
LSO	Large send offload
LTO	Link-time optimization
MMIO	Memory-mapped I/O
MSB	Most significant bit

<b>Term</b>	<b>Description</b>
MSS	Memory subsystem
MST	Mellanox software tools
NAT	Network address translation
NIC	Network interface card
NIST	National Institute of Standards and Technology
NS	Namespace
OCD	On-chip debugger
OOB	Out-of-band
OS	Operating system
OVS	Open vSwitch
PBS	Peak burst size
PCIe	PCI Express; Peripheral Component Interconnect Express
PF	Physical function
PIR	Peak information rate
PK	Platform key
PKA	Public key accelerator
POC	Point of coherence
RD	Read
RDMA	Remote direct memory access
RegEx	Regular expression
REQ	Request
RES	Response
RMC	Remote management controller
RN	Request node RN-F – Fully coherent request node RN-D – IO coherent request node with DVM support RN-I – IO coherent request node

<b>Term</b>	<b>Description</b>
RNG	Random number generator/generation
RoCE	Ethernet and RDMA over converged Ethernet
RQ	Receive queue
RShim	Random Shim
RTT	Round-trip time
RX	Receive
SA	Security association
SBSA	Server base system architecture
SDK	Software development kit
SF	Sub-function or scalable function
SG	Scatter-gather
SHA	Secure hash algorithm
SMMU	System memory management unit
SNP	Snooping
SQ	Send queue
SR-IOV	Single-root IO virtualization
STL	Stall
Sync event	Synchronization event
TBU	Translation buffer unit
TIR	Transport interface receive
TIS	Transport interface send
TLS	Transport layer security
TRB	Trail buffer
TSO	TCP send offload
TSO	Total store order

<b>Term</b>	<b>Description</b>
TX	Transmit
UDS	Unix domain socket
UEFI	Unified extensible firmware interface
UPVS	UEFI persistent variable store
VF	Virtual function
VFE	Virtio full emulation
VM	Virtual machine
VPI	Virtual protocol interconnect
VST	Virtual switch tagging
WorkQ or workq	Work queue
WQE	Work queue elements
WR	Write
WRDB	Write data buffer

## Related Documentation

<b>Document Name</b>	<b>Description</b>
InfiniBand Architecture Specification, Vol. 1, Release 1.3.1	The InfiniBand Architecture Specification that is provided by IBTA
Firmware Release Notes	See <a href="#">Firmware Release Notes</a>

<b>Document Name</b>	<b>Description</b>
MFT Documentation	See Firmware Tools <a href="#">Release Notes and User Manual</a>
NVIDIA OFED for Linux User Manual	Intended for system administrators responsible for the installation, configuration, management and maintenance of the software and hardware of VPI adapter cards
WinOF Documentation	See WinOF <a href="#">Release Notes and User Manual</a>
<a href="#">NVIDIA BlueField BMC Software User Manual</a>	This document provides general information concerning the BMC on the NVIDIA® BlueField® DPU, and is intended for those who want to familiarize themselves with the functionality provided by the BMC
<a href="#">NVIDIA BlueField-3 DPU User Guide</a>	This document provides details as to the interfaces of the board, specifications, required software and firmware for operating the board, and a step-by-step plan of how to bring up BlueField-3 DPUs
<a href="#">NVIDIA BlueField-2 Ethernet DPU User Guide</a>	This document provides details as to the interfaces of the board, specifications, required software and firmware, and a step-by-step plan of how to bring up BlueField-2 Ethernet DPUs
<a href="#">NVIDIA BlueField-2 InfiniBand/Ethernet DPU User Guide</a>	This document provides details as to the interfaces of the board, specifications, required software and firmware, and a step-by-step plan of how to bring up BlueField-2 InfiniBand/Ethernet DPUs
<a href="#">NVIDIA BlueField InfiniBand/Ethernet DPU User Guide</a>	This document provides details as to the interfaces of the board, specifications, required software and firmware, and a step-by-step plan of how to bring up BlueField InfiniBand/Ethernet DPUs
<a href="#">NVIDIA DOCA SDK</a>	The NVIDIA DOCA™ SDK enables developers to rapidly create applications and services on top of NVIDIA® BlueField® data processing units (DPUs), leveraging industry-standard APIs. With DOCA,

<b>Document Name</b>	<b>Description</b>
	developers can deliver breakthrough networking, security, and storage performance by harnessing the power of NVIDIA's DPUs.
NVIDIA BlueField Reference Platform Hardware User Manual	Provides details as to the interfaces of the reference platform, specifications and hardware installation instructions
NVIDIA BlueField Ethernet Controller Card User Manual	This document provides details as to the interfaces of the board, specifications, required software and firmware for operating the card, hardware installation, driver installation and bring-up instructions
NVIDIA BlueField UEFI Secure Boot User Guide	This document provides details and directions on how to enable UEFI secure boot and sign UEFI images
NVIDIA BlueField Secure Boot User Guide	This document provides guidelines on how to enable the Secure Boot on BlueField DPUs
NVIDIA BlueField SNAP and virtio-blk SNAP Documentation	This document describes the configuration parameters of NVMe SNAP and virtio-blk SNAP in detail
PKA Driver Design and Implementation Architecture Document	This document provides a description of the design and implementation of the Public Key accelerator (PKA) hardware driver. The driver manages and controls the EIP-154 Public Key Infrastructure Engine, an <a href="#">FIPS 140-3</a> compliant PKA and operates as a co-processor to offload the processor of the host.
PKA Programming	This document is intended to guide a new crypto application developer or a public key user space driver. It offers programmers the basic

<b>Document Name</b>	<b>Description</b>
Guide	information required to code their own PKA-based application for NVIDIA® BlueField® DPU.

# Initial Configuration

The following pages provide instructions regarding general configuration of the BlueField DPU.

- [UEFI Menu](#)
- [System Configuration and Services](#)
- [Host-side Interface Configuration](#)
- [Secure Boot](#)
- [Default Passwords and Policies](#)

## UEFI Menu

Unified Extensible Firmware Interface (UEFI) is low-level firmware that is part of the NVIDIA® BlueField® bootloader stack. UEFI acts as an interface between the BlueField's Arm-trusted firmware (ATF) bootloader and the OS.

### Info

The UEFI specification is available at [UEFI.org](#).

UEFI provides a menu which supports certain configuration options. This section lists and describes configurations supported from the UEFI Device Manager menu.

### Info

For more complete information beyond the Device Manager menu option, please refer to the [NVIDIA Networking Server-Side Documentation of Flexboot & UEFI](#) > User Manual > User Interface > HII (UEFI) System Settings Configuration Options.

### **Info**

Most of these menu items are also configurable via [Redfish](#) (when enabled).

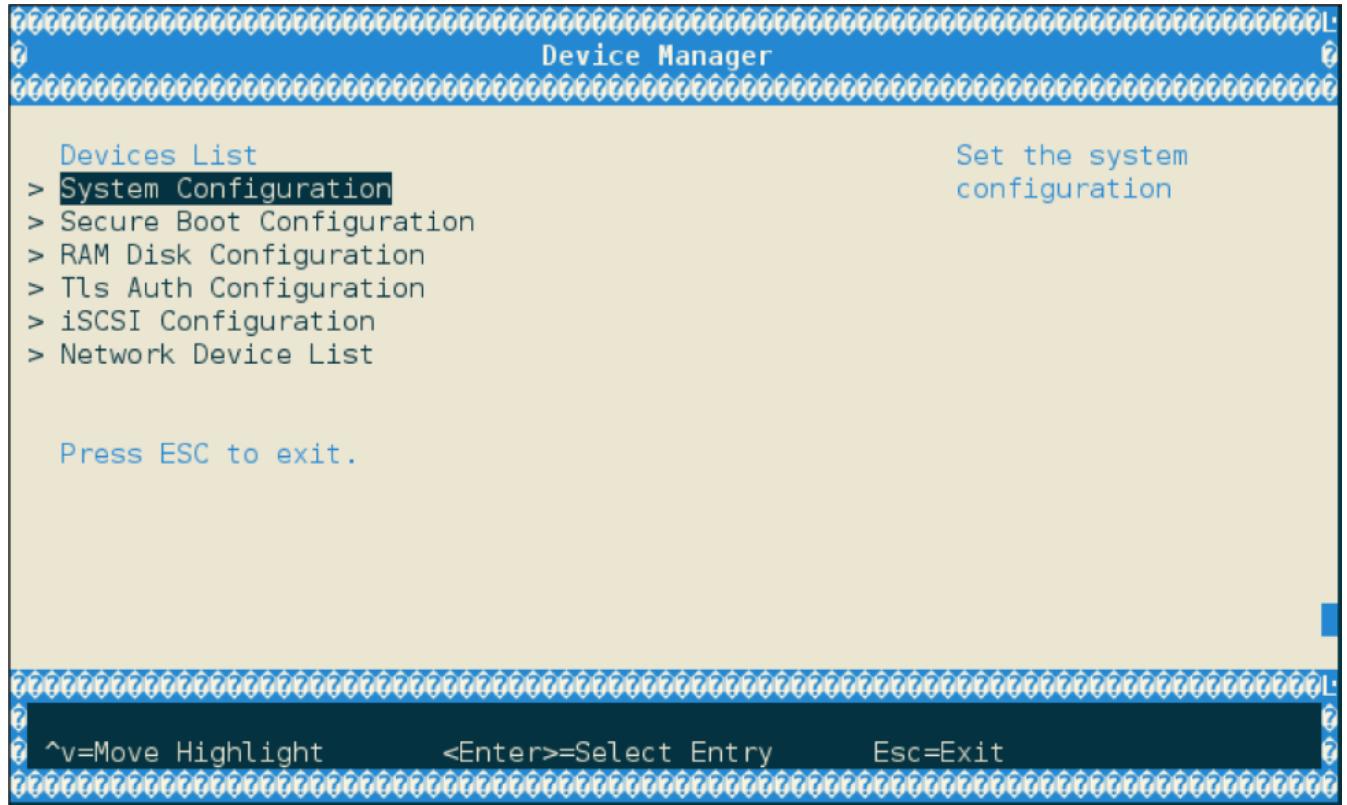
To access the UEFI menu, users must have a connection to the BlueField console either through a UART serial port or the virtual RShim console device. To enter the UEFI menu, hit the Esc key twice during the normal boot sequence.

### **Note**

All BlueField platforms ship with a default UEFI menu password, bluefield. If the password is set to bluefield when you enter the UEFI menu, users are prompted to change it.

### **Tip**

NVIDIA strongly recommends all DPUs have their UEFI password set to a non-default value. This can be done using the UEFI menu or Redfish.



## System Configuration

Lists different system configuration options.

### *(i)* Note

Some configuration options may require a system reset to take effect.



Menu Option	Description
Set Password	<p>Set the system password.</p> <p>Set the UEFI password. All BlueField Platforms ship with a default UEFI menu password, bluefield. If the password is set to bluefield when you enter the UEFI menu, users are prompted to change it.</p> <p><b>Tip</b></p> <p>NVIDIA strongly recommends all DPUs have their UEFI password set to a non-default value. This can be done using the UEFI menu or Redfish.</p>

Menu Option	Description
Select SPCR UART	<p>Choose UART for serial port console redirection [&lt;Disabled&gt;   &lt;UART Port 0&gt;   &lt;UART Port 1&gt;].</p> <p>Users may set the SPCR table (ACPI) to point to UART0, UART1, or disable the feature. The OS can reference this table to steer serial output. For example, Linux uses this table for its earlycon feature.</p> <div style="background-color: #f0e6e6; padding: 10px;"> <p> <b>Warning</b></p> <p>Leave this attribute to its default if you are not certain how to configure it, or you may destabilize your system.</p> </div>
Enable SMMU	<p>Enable/disable the SMMU.</p> <p>BlueField Platforms have an integrated SMMU on the SoC. Users may enable or disable this unit. Enabling it can make the system more secure but, with certain network flows, the enabled SMMU could cause performance issues.</p> <div style="background-color: #f0e6e6; padding: 10px;"> <p> <b>Warning</b></p> <p>Leave this attribute to its default if you do not certain how to configure it.</p> </div>
Disable SPMI	<p>Enable/disable ACPI server platform management interface table.</p> <p>Allows users to enable/disable the ACPI SPMI table. This table instructs the OS on what interface/device to use for the IPMI SSIF.</p> <div style="background-color: #f0e6e6; padding: 10px;"> <p> <b>Warning</b></p> <p>Leave this attribute to its default if you do not certain how to configure it.</p> </div>

Menu Option	Description
Enable 2nd eMMC	<p>Enable/disable the second eMMC.</p> <p>Some legacy BlueField systems have 2 eMMC devices. This feature has been discontinued.</p> <div style="background-color: #f0e6e6; padding: 10px;"> <p><b>⚠️ Warning</b></p> <p>Leave this attribute to its default (disabled) if you do not certain how to configure it, or your system will not boot correctly.</p> </div>
Boot Partition Protection	<p>Enable/disable the eMMC boot partition protection. Takes effect after reboot.</p> <p>There are 2 logical "boot partitions" on the eMMC device used to store ATF/UEFI code. These are referred to as the primary/secondary boot partitions. Users can write-protect these partitions using this attribute.</p> <div style="background-color: #ffffcc; padding: 10px;"> <p><b> ⓘ Info</b></p> <p>These are separate devices from the flash storage used by the OS (for file systems). They do not contain file systems and are only used for storing binary boot code on raw flash. Do not confuse an eMMC boot partition with an EFI System Partition (ESP) used to store boot loaders and OS images on a FAT32 file system.</p> </div> <div style="background-color: #ffffcc; padding: 10px;"> <p><b> ⓘ Info</b></p> <p>If secure boot is enabled, these partitions are write-protected by default.</p> </div> <div style="background-color: #ffffcc; padding: 10px;"> <p><b> ⓘ Note</b></p> </div>

Menu Option	Description
	This menu option is not currently supported for BlueField-3.
Disable PCIe	<p>Enable/disable PCIe root complex.      Normally, UEFI enumerates the PCIe bus during the boot process and reports this information to the OS via the ACPI SSDT table. If this attribute is disabled, UEFI does not populate the SSDT with the PCIe root complex information, so the OS does not have visibility to devices on the PCIe bus.</p> <p> <b>Note</b>      This attribute is used for diagnostic purposes and should not be modified.</p>
Enable OP-TEE	<p>Enable/disable support for trusted execution environment.</p> <p> <b>Warning</b>      Do not enable this feature. More information will be provided in future releases.</p>

Menu Option	Description
Disable TMFF	<p>Enable/disable the BlueField-specific ACPI TMFIFO table. This can be used by some OSes to perform console/debugging over the BlueField TMFIFO interface. It can override the SPCR table.</p> <div style="background-color: #f0e6e6; padding: 10px;"> <p> <b>Warning</b></p> <p>Leave this attribute to its default if you do not certain how to configure it.</p> </div>
Disable Force Pxe Retry	If enabled, PXE boot option entries are attempted only once instead of retrying them in a loop when "ForcePxe" is requested via IPMI interface
Field Mode	<p>Disable/enable NIC BMC field mode. Allows users to enable/disable NIC BMC field mode. When the NIC BMC has field mode enabled, most of its functionality is disabled (beyond the serial console). The BlueField Platform's OOB interface will also not be functional if field mode is enabled.</p> <div style="background-color: #f0e6e6; padding: 10px;"> <p> <b>Warning</b></p> <p>Leave this attribute to its default unless you are certain you wish to enable field mode on the NIC BMC. Consult the DPU BMC user manual for more information on field mode.</p> </div>
Set RTC	Allows users to set the time and date for the real-time clock.
BlueField	<ul style="list-style-type: none"> <li>Internal CPU Model: [&lt;Separated&gt;   &lt;Embedded&gt;]</li> <li>Host Privilege Level: [&lt;Restricted&gt;   &lt;Privileged&gt;]</li> <li>NIC Mode – sets the BlueField to operate in either NIC mode or DPU mode</li> </ul>

Menu Option	Description
Modes	<p><b>(i) Note</b></p> <p>Any change to this attribute requires device reset to take effect.</p>
Redfish Configuration	<p>Enable/disable Redfish support. If UEFI is unable to discover a Redfish server, it reverts to using the defined UEFI boot options (i.e., the "normal" UEFI boot sequence). Disabling Redfish helps improve boot time as the Redfish server discovery process is skipped.</p> <p>The RTCSync option syncs RTC time with Redfish time under the Manager schema.</p>
Password Settings	<ul style="list-style-type: none"> <li>Default Password Policy – mandates the password being set adheres to the new policy of 12 characters minimum and 64 characters maximum. The last 5 passwords cannot be reused.</li> <li>Set Legacy Password – set password with legacy password policy to accommodate a UEFI firmware downgrade. The new password policy (default) is not compatible with older versions of UEFI firmware.</li> </ul>
Reset EFI Variables	<p>This action clears all EFI variables to factory default state. Reset the device to take effect.</p> <p><b>⚠ Warning</b></p> <p>Only reset the EFI variable store under the advice of NVIDIA Enterprise Support. Resetting the EFI variable store deletes all UEFI variables including the boot options and the system may not boot without setting new boot options.</p>
Emmc Wipe	Clears the eMMC disk. The action is immutable and all data on eMMC is lost after it is performed.

Menu Option	Description
Nvme Wipe	Clears the NVMe SSD. This action is immutable and all data on NVMe SSD is lost after it is performed.
Large ICMC size	<p>Set the large ICMC size in Hex and MB. Valid value: 0-100000h in 80h increments.</p> <div style="background-color: #ffffcc; padding: 10px;"> <span style="color: #0070C0; font-size: 1.5em;"> ⓘ </span> <b>Info</b>            This menu option is only relevant for BlueField-3 platforms.         </div>

## Secure Boot Configuration

Please refer to section "[UEFI Secure Boot](#)" for more information.

## RAM Disk Configuration

Provides option to create/delete RAM disks.

```
ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooL
?                                     RAM Disk HII Main Screen
ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooL
Disk Memory Type:          <Boot Service Data>      Specifies type of
                            memory to use from
                            available memory pool
                            in system to create a
                            disk.
> Create raw
> Create from file
Created RAM disk list:
Remove selected RAM disk(s).

ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooL
? ^v=Move Highlight      <Enter>=Select Entry   Esc=Exit
ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooL
```

## Tls Auth Configuration

Provides configuration (enroll/delete) of TLS auth certificates for HTTPS traffic in UEFI.

### Note

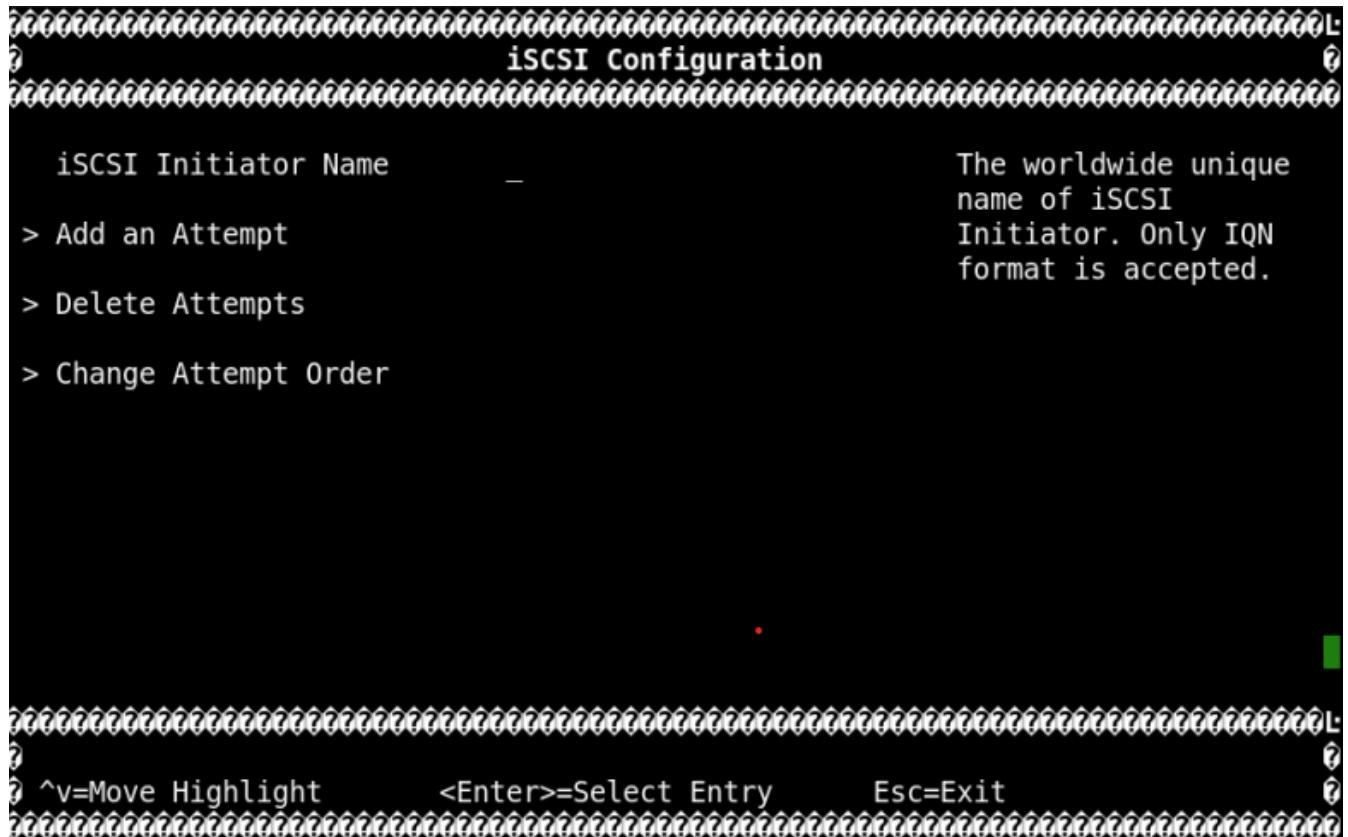
If TLS Auth certificate is configured then all HTTPS traffic on all network interfaces will be verified. UEFI only supports Server CA configuration, Client CA configuration is currently not supported.

```
ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooL
?                                     Tls Auth Configuration          ?
ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooL
?  
 > Server CA Configuration                               Press <Enter> to  
 > Client Cert Configuration                         configure Server CA.  
  
ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooL
?  
 ^v=Move Highlight      <Enter>=Select Entry      Esc=Exit  
ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooL
```

```
ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooL
?                                     Server CA Configuration          ?
ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooL
?  
 > Enroll Cert                                         Press <Enter> to  
 > Delete Cert                                       enroll cert.  
  
ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooL
?  
 ^v=Move Highlight      <Enter>=Select Entry      Esc=Exit  
ooooooooooooooooooooooooooooooooooooooooooooooooooooL
```

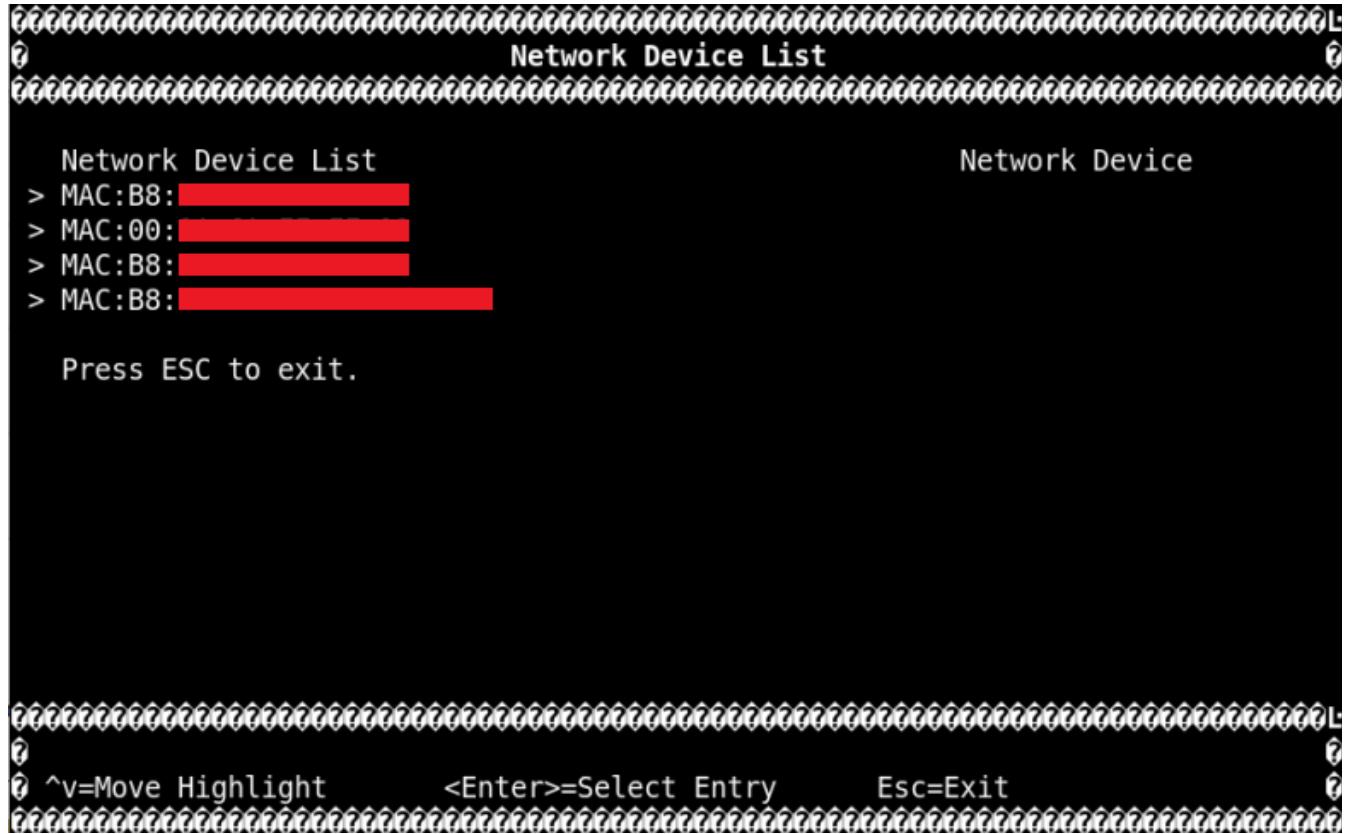
# iSCSI Configuration

Provides configuration options for iSCSI.

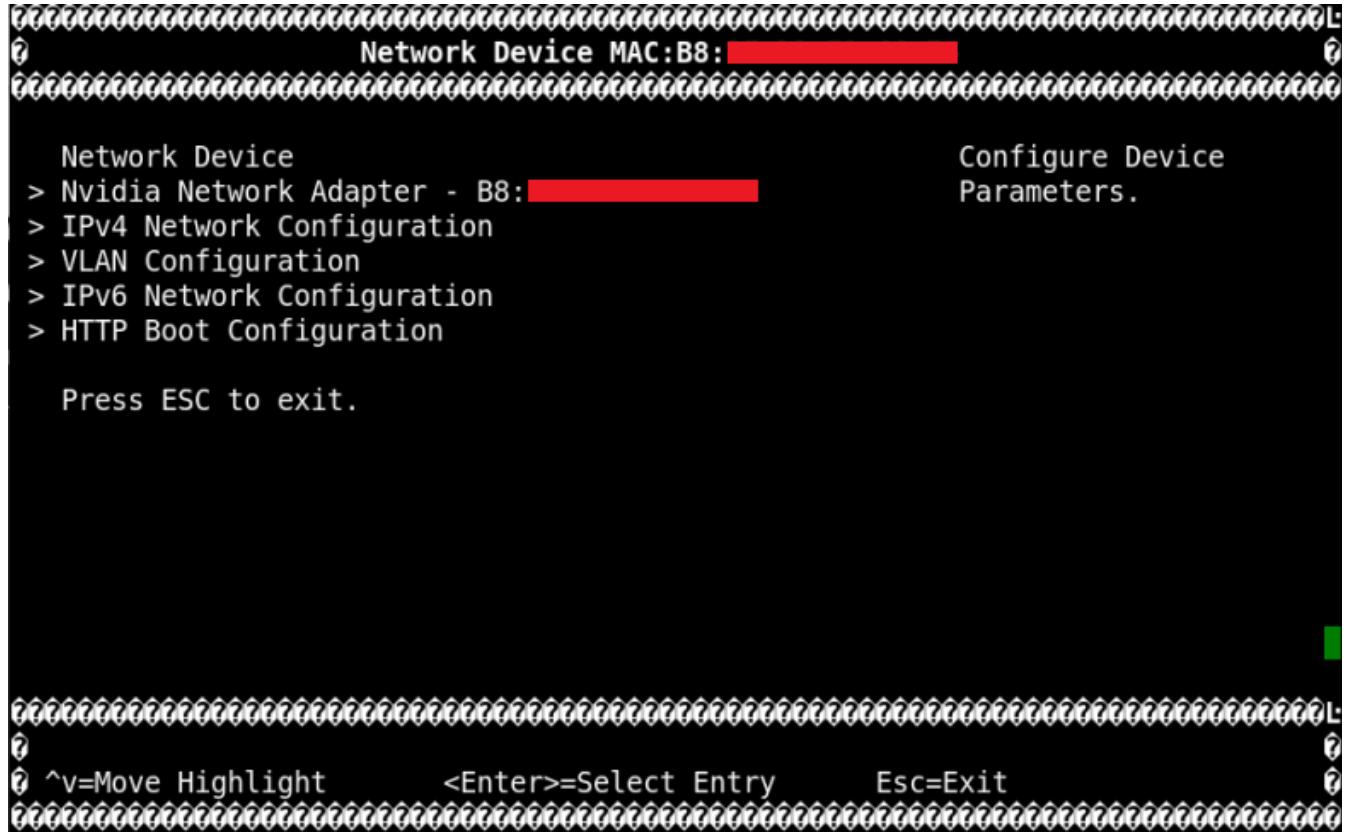


# Network Device List

Lists the MAC addresses of the available network interfaces in UEFI.



Users can find more information (Link status, Link speed, PCI ID, Link type, etc.) on each interface upon selection. Users can also configure the interfaces (IPv4, IPv6, VLAN, HTTP BOOT) as needed.



The following menu can be reached by selecting the Nvidia Network Adapter - <mac-address> menu options:

```

Main Configuration Page

> Firmware Image Properties          View device firmware
> NIC Configuration                  version information.
> Power Configuration
> Device Level Configuration
> BlueField External Host Priv Configuration
> BlueField Internal Cpu Configuration
  Blink LEDs                      [0]
  Device Name                     Nvidia Network Adapter
  Chip Type                       BlueField-3
  PCI Device ID                  A2DC
  PCI Address                     03:00:00
  Link Status                     <Disconnected>
  Link Speed                      <NA>
  Network Link Type              <InfiniBand>
  MAC Address                     B8: [REDACTED]

^v=Move Highlight    <Enter>=Select Entry   Esc=Exit

```

# System Configuration and Services

This page provides information on system services and scripts based on the default DPU OS (i.e., Ubuntu).

## First Boot After BFB Installation

During the first boot, the cloud-init service configures the system based on the data provided in the following files:

- /var/lib/cloud/seed/nocloud-net/network-config – network interface configuration
- /var/lib/cloud/seed/nocloud-net/user-data – default users and commands to run on the first boot

## RDMA and ConnectX Driver Initialization

RDMA and NVIDIA® ConnectX® drivers are loaded upon boot by the openibd.service.

## Note

The mlx5\_core kernel module is loaded automatically by the kernel as a registered device driver.

One of the kernel modules loaded by the `openibd.service`, `ib_umad`, triggers modprobe rule from `/etc/modprobe.d/mlnx-bf.conf` file that runs the `/sbin/mlnx_bf_configure` script. See [Default Ports and OVS Configuration](#) for more information.

## Firewall Configuration

The BFB image includes the following firewall configuration (enabled by default):

```
$ cat /etc/iptables/rules.v4

*mangle
:PREROUTING ACCEPT [45:3582]
:INPUT ACCEPT [45:3582]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [36:4600]
:POSTROUTING ACCEPT [36:4600]
:KUBE-IPTABLES-HINT - [0:0]
:KUBE-KUBELET-CANARY - [0:0]
COMMIT
*filter
:INPUT ACCEPT [41:3374]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [32:3672]
:DOCKER-USER - [0:0]
:KUBE-FIREWALL - [0:0]
:KUBE-KUBELET-CANARY - [0:0]
:LOGGING - [0:0]
:POSTROUTING - [0:0]
:PREROUTING - [0:0]
```

```
-A INPUT -j KUBE-FIREWALL
-A INPUT -p tcp -m tcp --dport 111 -j REJECT --reject-with icmp-port-unreachable
-A INPUT -p udp -m udp --dport 111 -j REJECT --reject-with icmp-port-unreachable
-A INPUT -i lo -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -d 127.0.0.0/8 -m mark --mark 0xb -m comment --comment MD_IPTABLES -j DROP
-A INPUT -m mark --mark 0xb -m state --state RELATED,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p tcp -m tcp ! --dport 22 ! --tcp-flags FIN,SYN,RST,ACK SYN -m mark --mark 0xb -m state --state NEW -m comment --comment MD_IPTABLES -j DROP
-A INPUT -f -m mark --mark 0xb -m comment --comment MD_IPTABLES -j DROP
-A INPUT -p tcp -m tcp --tcp-flags FIN,SYN,RST,PSH,ACK,URG
FIN,SYN,RST,PSH,ACK,URG -m mark --mark 0xb -m comment --comment MD_IPTABLES -j DROP
-A INPUT -p tcp -m tcp --tcp-flags FIN,SYN,RST,PSH,ACK,URG NONE -m mark --mark 0xb -m comment --comment MD_IPTABLES -j DROP
-A INPUT -m mark --mark 0xb -m state --state INVALID -m comment --comment MD_IPTABLES -j DROP
-A INPUT -p tcp -m tcp --tcp-flags RST RST -m mark --mark 0xb -m hashlimit --
hashlimit-above 2/sec --hashlimit-burst 2 --hashlimit-mode srcip --hashlimit-name hashlimit_0 --hashlimit-htable-expire 30000 -m comment --comment MD_IPTABLES -j DROP
-A INPUT -p tcp -m mark --mark 0xb -m state --state NEW -m hashlimit --hashlimit-above 50/sec --hashlimit-burst 50 --hashlimit-mode srcip --hashlimit-name hashlimit_1 --hashlimit-htable-expire 30000
-m comment --comment MD_IPTABLES -j DROP
-A INPUT -p tcp -m mark --mark 0xb -m conntrack --ctstate NEW -m hashlimit --
hashlimit-above 60/sec --hashlimit-burst 20 --hashlimit-mode srcip --hashlimit-name hashlimit_2 --hashlimit-htable-expire 30000 -m comment --comment MD_IPTABLES -j DROP
-A INPUT -m mark --mark 0xb -m recent --rcheck --seconds 86400 --name portscan --mask 255.255.255.255 --rsource -m comment --comment MD_IPTABLES -j DROP
-A INPUT -m mark --mark 0xb -m recent --remove --name portscan --mask 255.255.255.255 --rsource -m comment --comment MD_IPTABLES
-A INPUT -p tcp -m tcp --dport 22 -m mark --mark 0xb -m conntrack --ctstate NEW -m recent --set --name DEFAULT --mask 255.255.255.255 --rsource -m comment --
```

```
comment MD_IPTABLES
-A INPUT -p tcp -m tcp --dport 22 -m mark --mark 0xb -m conntrack --ctstate NEW -m recent --update --seconds 60 --hitcount 50 --name DEFAULT --mask 255.255.255.255 --rsource -m comment --comment MD_IPTABLES -j DROP

-A INPUT -p tcp -m tcp --dport 443 -m mark --mark 0xb -m conntrack --ctstate NEW -m recent --set --name DEFAULT --mask 255.255.255.255 --rsource -m comment --comment MD_IPTABLES
-A INPUT -p tcp -m tcp --dport 443 -m mark --mark 0xb -m conntrack --ctstate NEW -m recent --update --seconds 60 --hitcount 10 --name DEFAULT --mask 255.255.255.255 --rsource -m comment --comment MD_IPTABLES -j DROP
-A INPUT -p udp -m udp --dport 161 -m mark --mark 0xb -m conntrack --ctstate NEW -m recent --set --name DEFAULT --mask 255.255.255.255 --rsource -m comment --comment MD_IPTABLES
-A INPUT -p udp -m udp --dport 161 -m mark --mark 0xb -m conntrack --ctstate NEW -m recent --update --seconds 60 --hitcount 100 --name DEFAULT --mask 255.255.255.255 --rsource -m comment --comment MD_IPTABLES -j DROP
-A INPUT -p tcp -m tcp --dport 22 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p tcp -m tcp --dport 443 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p tcp -m tcp --dport 179 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 68 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 122 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 161 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 6306 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 69 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 389 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
```

```
-A INPUT -p tcp -m tcp --dport 389 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 1812:1813 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 49 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p tcp -m tcp --dport 49 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --sport 53 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p tcp -m tcp --sport 53 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 500 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 4500 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 1293 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p tcp -m tcp --dport 1293 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 1707 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p tcp -m tcp --dport 1707 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -i lo -p udp -m udp --dport 3786 -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -i lo -p udp -m udp --dport 33000 -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p icmp -m mark --mark 0xb -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --sport 5353 --dport 5353 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 33434:33523 -m mark --mark 0xb -m comment --comment MD_IPTABLES -j REJECT --reject-with icmp-port-unreachable
-A INPUT -p udp -m udp --dport 123 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
```

```
-A INPUT -p udp -m udp --dport 514 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p udp -m udp --dport 67 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment MD_IPTABLES -j ACCEPT
-A INPUT -p tcp -m tcp --dport 60102 -m mark --mark 0xb -m conntrack --ctstate NEW,ESTABLISHED -m comment --comment "MD_IPTABLES: Feature HA port" -j ACCEPT
-A INPUT -m mark --mark 0xb -m comment --comment MD_IPTABLES -j LOGGING
-A FORWARD -j DOCKER-USER
-A OUTPUT -o oob_net0 -m comment --comment MD_IPTABLES -j ACCEPT
-A DOCKER-USER -j RETURN

-A LOGGING -m mark --mark 0xb -m comment --comment MD_IPTABLES -j NFLOG --nflog-prefix "IPTables-Dropped: " --nflog-group 3
-A LOGGING -m mark --mark 0xb -m comment --comment MD_IPTABLES -j DROP
-A PREROUTING -i oob_net0 -m comment --comment MD_IPTABLES -j MARK --set-xmark 0xb/0xffffffff
-A PREROUTING -p tcp -m tcpmss ! --mss 536:65535 -m tcp ! --dport 22 -m mark --mark 0xb -m conntrack --ctstate NEW -m comment --comment MD_IPTABLES -j DROP
COMMIT
*nat
:PREROUTING ACCEPT [1:320]
:INPUT ACCEPT [1:320]
:OUTPUT ACCEPT [8:556]
:POSTROUTING ACCEPT [8:556]
:KUBE-KUBELET-CANARY - [0:0]
:KUBE-MARK-DROP - [0:0]
:KUBE-MARK-MASQ - [0:0]
:KUBE-POSTROUTING - [0:0]
-A POSTROUTING -m comment --comment "kubernetes postrouting rules" -j KUBE-POSTROUTING
-A KUBE-MARK-DROP -j MARK --set-xmark 0x8000/0x8000
-A KUBE-MARK-MASQ -j MARK --set-xmark 0x4000/0x4000
-A KUBE-POSTROUTING -m mark ! --mark 0x4000/0x4000 -j RETURN
-A KUBE-POSTROUTING -j MARK --set-xmark 0x4000/0x0
```

```
-A KUBE-POSTROUTING -m comment --comment "kubernetes service traffic  
requiring SNAT" -j MASQUERADE --random-fuzzy  
COMMIT
```

This configuration is provided by the bf-release package and is installed during the first boot of the Ubuntu OS after the BFB installation using the cloud-init service and the /var/lib/cloud/seed/nocloud-net/user-data configuration file.

To disable this default firewall configuration after OS is UP, run:

```
$ rm -f /etc/iptables/rules.v4  
$ iptables -F
```

To disable this default firewall configuration during the BFB installation, use bf.cfg with the following command in the bfb\_modify\_os function:

```
bfb_modify_os()  
{  
    perl -ni -e "if(/^write_files:/../^users/) {next unless m{^users}; print} else {print}"  
    /mnt/var/lib/cloud/seed/nocloud-net/user-data  
}
```

## Host-side Interface Configuration

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
```

If the RShim device does not appear, refer to section "[RShim Troubleshooting and How-Tos](#)".

## 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
```

### 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 bares 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

#### (i) 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).

**(i) 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.

**(i) Note**

For comprehensive list of the supported parameters to customize bf.cfg during BFB installation, refer to section "[bf.cfg Parameters](#)".

## 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-tm fifo\_net0. Run:

```
# vim /etc/sysconfig/network-scripts/ifcfg-tm fifo_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
```

For more information and an example of the script that covers multiple DPU installation and configuration, refer to section "[Installing Full DOCA Image on Multiple DPUs](#)" of the *NVIDIA DOCA Installation Guide*.

## 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. Please refer to [How to use the UEFI boot menu](#) for more information about UEFI operations related to the OOB interface.

## 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\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](#)".

## Secure Boot

These pages provide guidelines on how to operate secured NVIDIA® BlueField® DPUs. They provide UEFI secure boot references for the UEFI portion of the secure boot process.

### Note

This section provides directions for illustration purposes, it does not intend to enforce or mandate any procedure about managing keys and/or production guidelines. Platform users are solely responsible of implementing secure strategies and safe approaches to manage their boot images and their associated keys and certificates.

### Note

Security aspects such as key generation, key management, key protection, and certificate generation are out of the scope of this section.

Secure boot is a process which verifies each element in the boot process prior to execution, and halts or enters a special state if a verification step fails at any point during the boot. It is based on an unmodifiable ROM code which acts as the root-of-trust (RoT) and uses an off-chip public key, to authenticate the initial code which is loaded from an

external non-volatile storage. The off-chip public key integrity is verified by the ROM code against an on-chip public key hash value stored in E-FUSES. Then the authenticated code and each element in the boot process cryptographically verify the next element prior to passing execution to it. This extends the chain-of-trust (CoT) by verifying elements that have their RoT in hardware. In addition, no external intervention in the authentication process is permitted to prevent unauthorized software and firmware from being loaded. There should be no way to interrupt or bypass the RoT with runtime changes.

## Supported BlueField DPUs

Secured BlueField devices have pre-installed software and firmware signed with NVIDIA signing keys. The on-chip public key hash is programmed into E-FUSES.

To verify whether the DPU in your possession supports secure boot, run the following command:

```
# sudo mst start  
# sudo flint -d /dev/mst/mt41686_pciconf0 q full | grep "Life cycle"  
Life cycle: GA SECURED
```

"GA SECURED" indicates that the BlueField device has secure boot enabled.

To verify whether the BlueField Arm has secure boot enabled, run the following command from the BlueField console:

```
ubuntu@localhost:~$ sudo mlxbf-bootctl | grep lifecycle  
lifecycle state: GA Secured
```

## Default Passwords and Policies

### BMC Passwords

The BMC password must comply with the following policy parameters:

- Using ASCII and Unicode characters is permitted
- Minimum length: 12

- Maximum length: 20
- Maximum number of consecutive character pairs: 4

 **Info**

Two characters are consecutive if  $|\text{hex}(\text{char\_1}) - \text{hex}(\text{char\_2})| = 1$ .

Examples of passwords with 5 consecutive character pairs  
(invalid): DcBa123456AbCd!; ab1XbcYcdZdeGef!; Testing\_123abcgh!.

The following is a valid example password:

- HelloNvidia3D!

 **Note**

A user account is locked for 10 minutes after 10 consecutive failed attempts.

## UEFI Menu Password

A password is required to enter the UEFI menu during BlueField bootup. The UEFI menu contains various settings which impact BlueField behavior. Therefore, it is very important to keep that password secure.

## Default Password

1. A first-time user accessing the UEFI menu must enter the default password for the UEFI menu, bluefield:



2. The user is prompted to provide a new password:



### Note

The new password entered above must be in compliance with the password policy:

- The password must be between 12 and 64 characters (inclusive)
- There are no requirements for upper/lower case, or special characters. Spaces are allowed.

3. The user is prompted to confirm the new password:

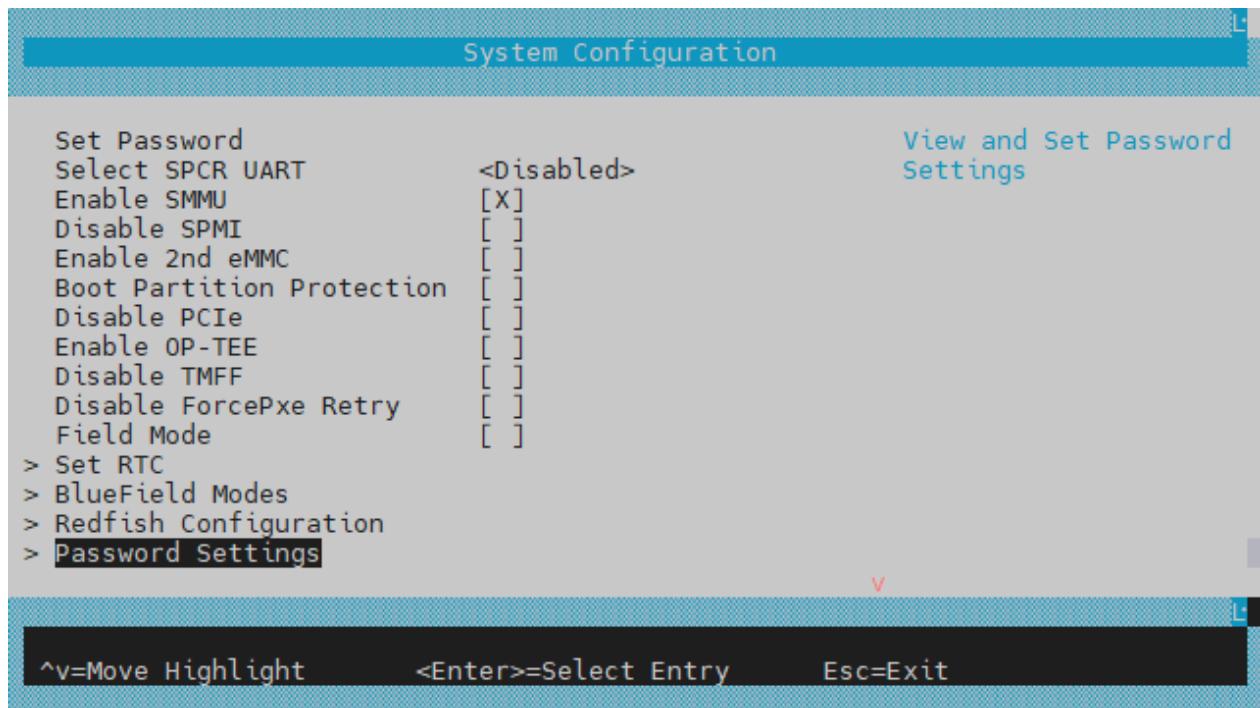


## Default Password Policy

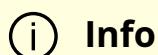
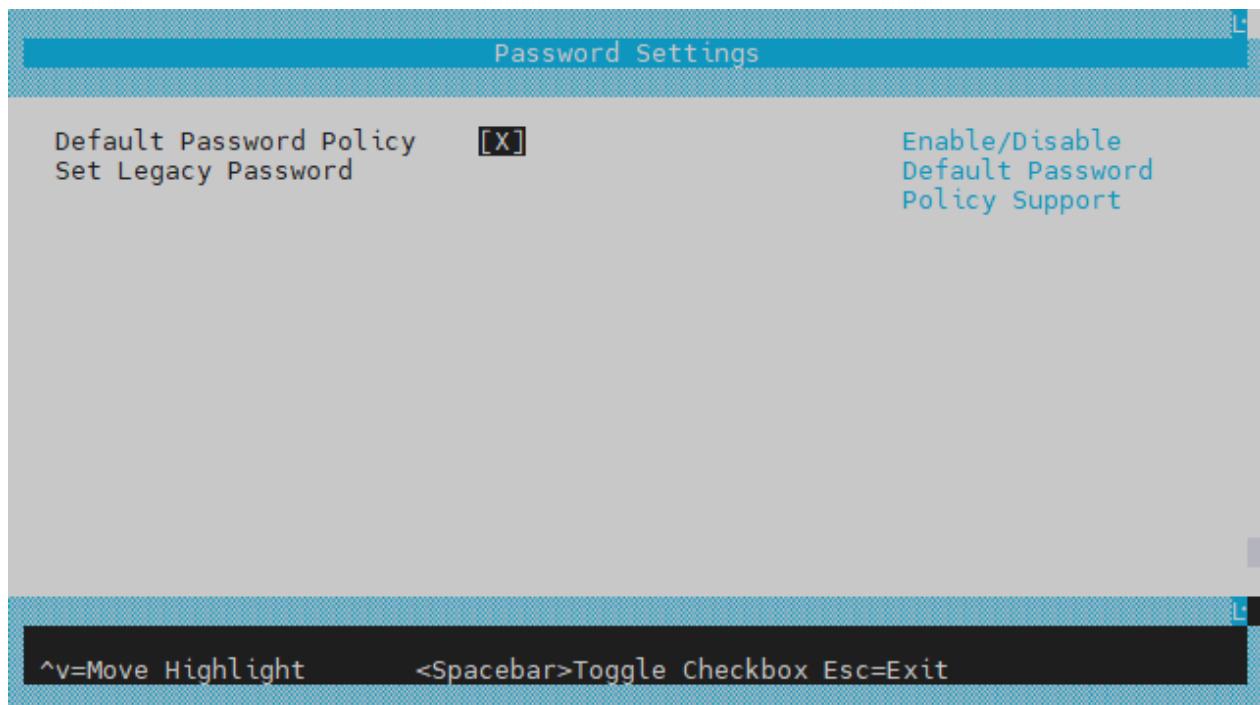
The user can enable/disable the UEFI password policy. The default password policy is enabled by default using a checkbox in the UEFI menu.

The user can browse the UEFI menu and disable as follows:

1. Navigate to "Device Configuration" > "System Configuration" > "Password Settings":

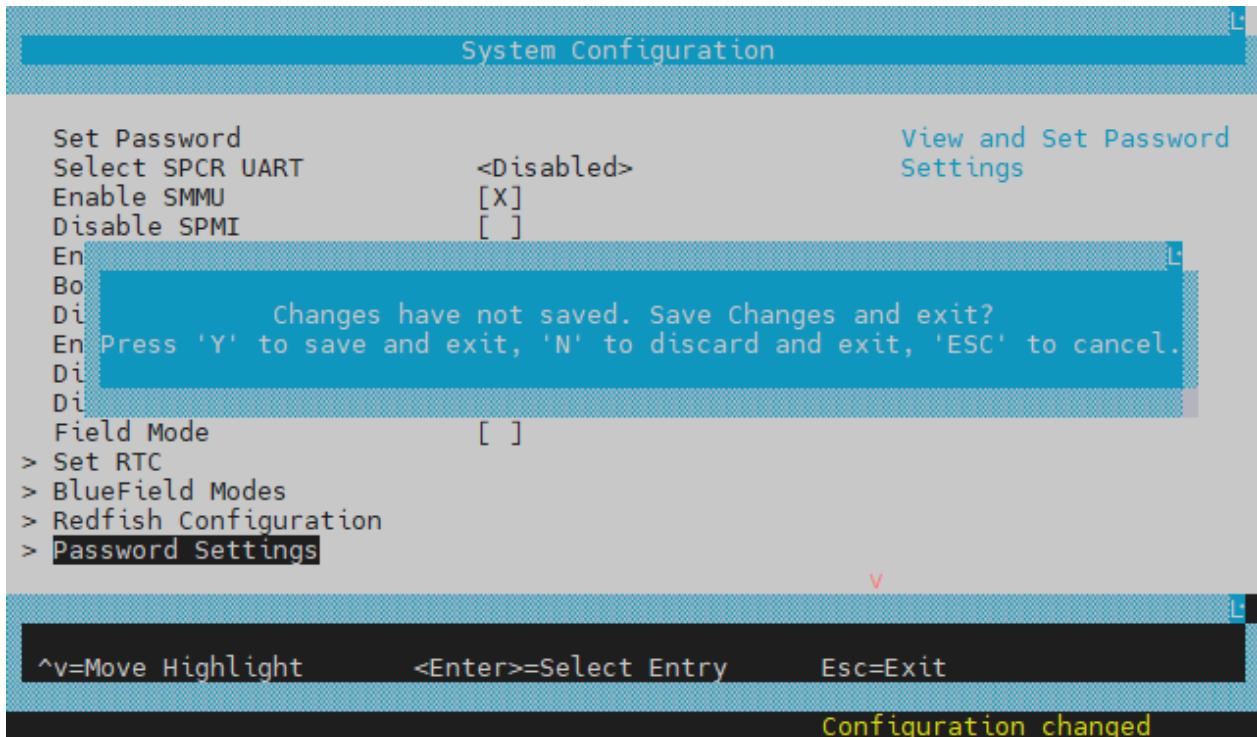


2. The "Default Password Policy" checkbox controls whether the more secure password policy is enabled:



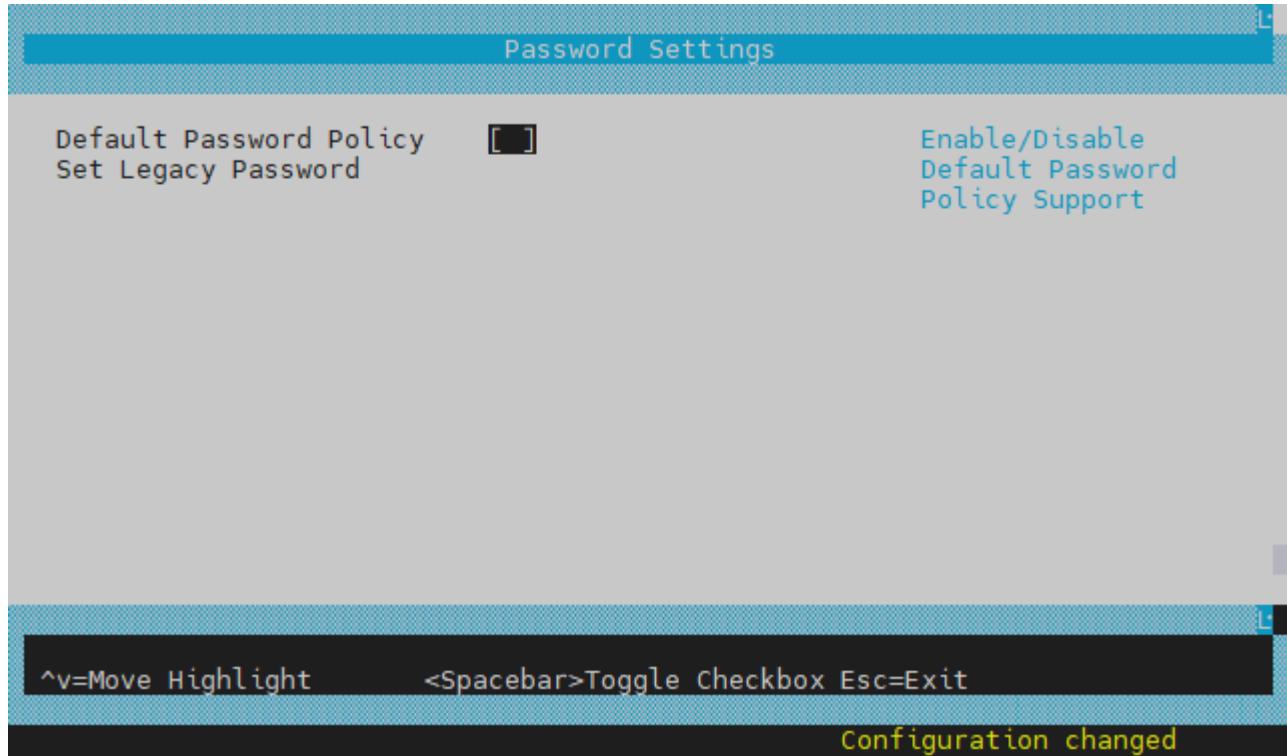
To disable the Default Password Policy, hit the spacebar to clear the checkbox.

3. The user must hit ESC ESC and answer "Y" to save the configuration change.



## Disabling Default Password Policy

To disable the Default Password Policy, hit the spacebar to clear the checkbox.



### Info

If the Default Password Policy is disabled, the password entered must be between 1 and 64 characters.

## Software Downgrade

The UEFI's password policy is not backward compatible. Although downgrade is not recommended, users are allowed to downgrade their software while their password is set. But, if and only if the password is set, users must configure the legacy password prior to performing any downgrade.

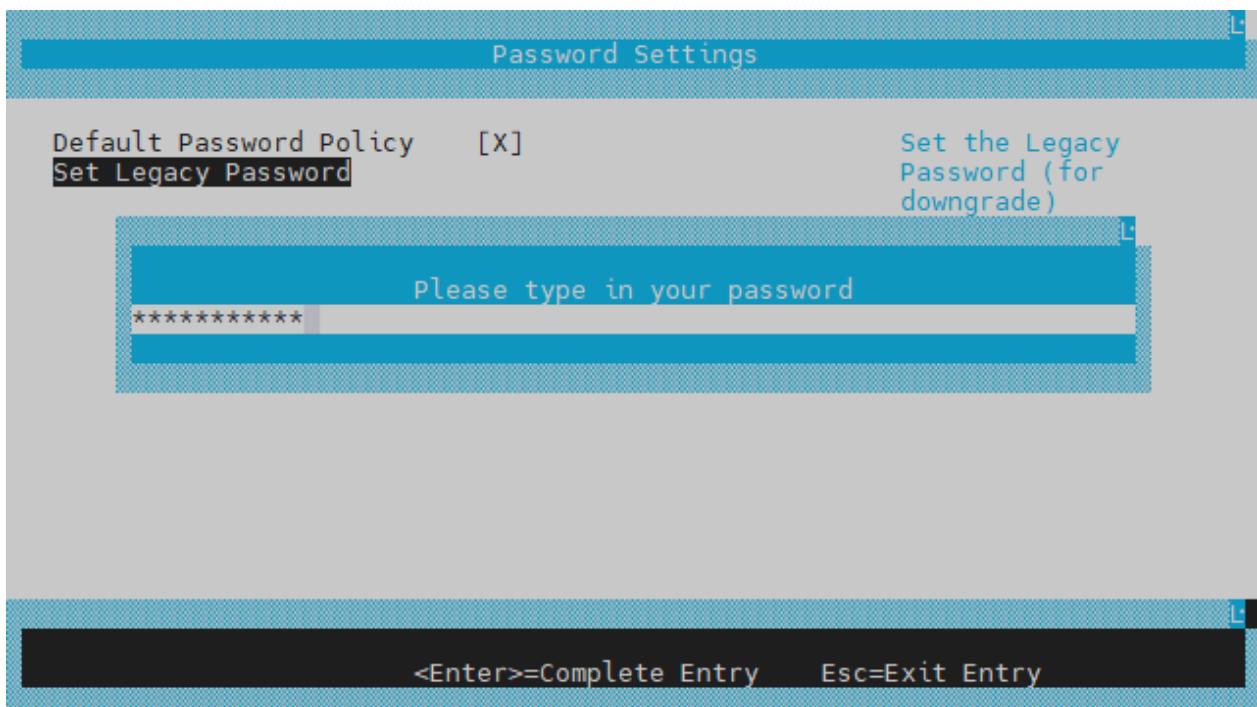
For BSP 4.6.0 (DOCA 2.6.0) or higher, users must change the UEFI password saved to the older "Legacy" format.

## **Warning**

If this procedure is not followed before performing a software downgrade, users would not be able to enter the UEFI menu.

In the UEFI menu:

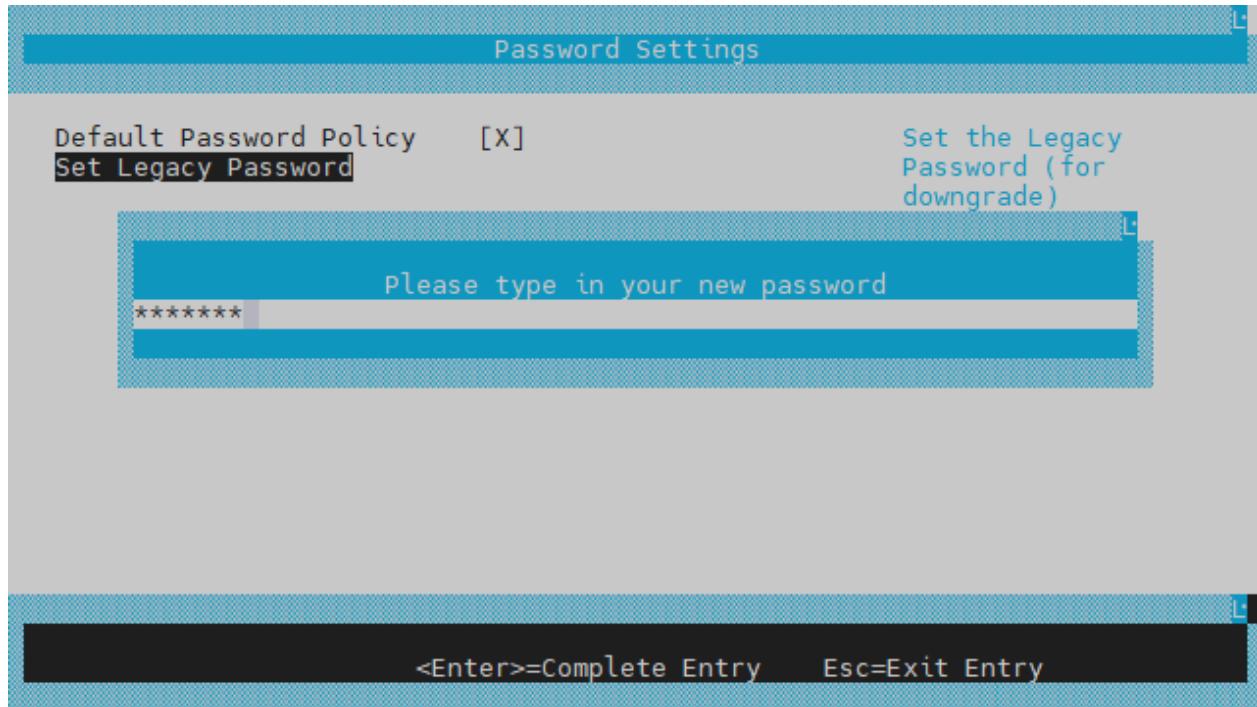
1. Navigate to "Device Manager" > "System Configuration" >"Password Settings" >" Set Legacy Password".
2. Select " Set Legacy Password ".
3. Enter your current password:



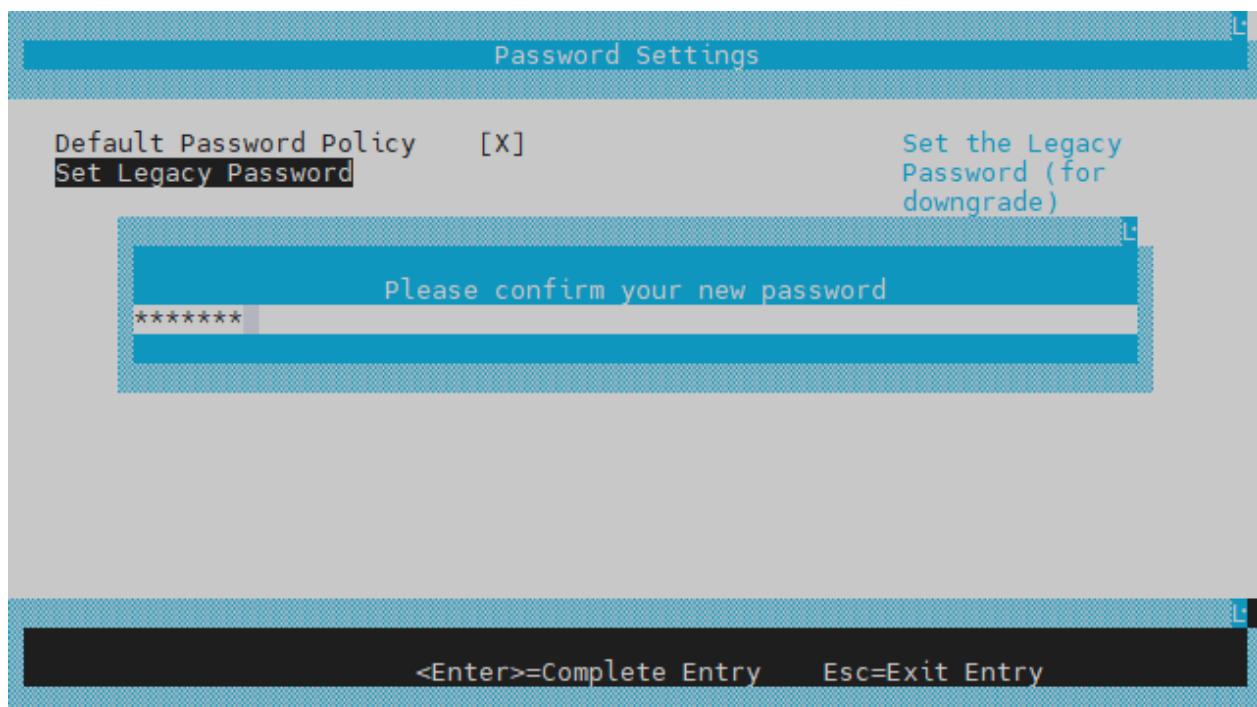
4. Type in a new legacy password between 1 and 20 characters:

## **Note**

The password format allows up to 64 characters but anything greater than 20 characters is not backward compatible.



##### 5. Confirm the new password:



Now, you may downgrade your BlueField image.

## Password Reset

To reset the UEFI menu password, users may use the ready to use capsule file `EnrollKeysCap` installed under `/lib/firmware/mellanox/boot/capsule/EnrollKeysCap` on the BlueField DPU file system. From the BlueField console, execute the following command, then reboot:

```
ubuntu@localhost:~$ bfrec --
capsule /lib/firmware/mellanox/boot/capsule/EnrollKeysCap
```

On the next reboot, the capsule file is processed, and the UEFI password is reset to bluefield.

## GRUB Password

GRUB menu entries are protected by a username and password to prevent unwanted changes to the default boot options or parameters.

The default credentials are as follows:

Username	admin
Password	BlueField

The password can be changed during BFB installation by providing a new `grub_admin_PASSWORD` parameter in `bf.cfg`:

```
# vim bf.cfg
grub_admin_PASSWORD='
grub.pbkdf2.sha512.10000.5EB1FF92FDD89BDAF3395174282C77430656A6DBEC1F92
```

To get a new encrypted password value use the command `grub-mkpasswd-pbkdf2`.

After the installation, the password can be updated by editing the file /etc/grub.d/40\_custom and then running the command update-grub which updates the file /boot/grub/grub.cfg.

---

# Release Notes

The release note pages provide information for NVIDIA® BlueField® DPU family software such as changes and new features, supported platforms, and reports on software known issues as well as bug fixes.

- [Changes and New Features](#)
- [Supported Platforms and Interoperability](#)
- [Bug Fixes In This Version](#)
- [Known Issues](#)
- [Validated and Supported Cables and Modules](#)
- [Release Notes Change Log History](#)
- [Bug Fixes History](#)

## Changes and New Features

 **Info**

For an archive of changes and features from previous releases, refer to [Release Notes Change Log History](#).

 **Info**

NVIDIA® BlueField ® DPUs support configuring network ports as either Ethernet only or InfiniBand only .

## Changes and New Features in 4.7.0

- Added support for new [BlueField reset and reboot procedures](#) for loading new firmware and firmware configuration changes which replace previous need for server power cycle
- Updated the default operation mode of SuperNICs to NIC mode (from DPU mode). This is relevant to the following SKUs:
  - 900-9D3B4-00CC-EA0
  - 900-9D3B4-00SC-EA0
  - 900-9D3B4-00CV-EA0
  - 900-9D3B4-00SV-EA0
  - 900-9D3B4-00EN-EA0
  - 900-9D3B4-00PN-EA0
  - 900-9D3D4-00EN-HA0
  - 900-9D3D4-00NN-HA0

### Note

When upgrading one of these SuperNICs to 2.7.0, if its mode of operation was changed at any point in the past, then the last configured mode of operation will remain unchanged. Otherwise, the SuperNIC will rise in NIC operation mode.

- Installing the BFB Bundle now performs NIC firmware update by default
- Added ability to install NIC firmware and BMC software in NIC mode in NVIDIA® BlueField®-3.

 **Note**

It is important to note the following:

- During BFB Bundle installation, Linux is expected to boot to upgrade NIC firmware and BMC software
- As Linux is booting during BFB Bundle installation, it is expected for the mlx5 core driver to timeout on the BlueField Arm
- During the BFB Bundle installation, it is expected for the mlx5 driver to error messages on the x86 host. These prints may be ignored as they are resolved by a mandatory, post-installation power cycle.
- It is mandatory to power cycle the host after the installation is complete for the changes to take effect

- Software packaging – new BlueField firmware bundle package (bf-fwbundle-<version>.prod.bfb), a smaller image for Day 2 upgrades, without the OS and DOCA runtime. Includes ATF, UEFI, nic-fw, bmc-fw, and eROT only.
- Improved BlueField BMC robustness –
  - Report LLDP for L2 discovery via Redfish
  - Improved BlueField DPU debuggability
- Increased support for virtio-net VF devices on BlueField-3 networking platforms to 2K
- Reduced power consumption for BlueField NIC mode

- RAS
  - Report DDR Error to OS, including both single-bit ECC error and UCE error
  - Support error injection in processors, memory, and PCIe devices

## Supported Platforms and Interoperability

### Supported NVIDIA BlueField-3 DPU Platforms

SKU	PSID	Description
900-9D3D4-00NN-HA0	MT_000001070	NVIDIA BlueField-3 B3140H E-series FHHL DPU; 400GbE(default mode)/NDR IB; Single-port QSFP112; PCIe Gen5.0 x16; 8 Arm cores; 16GB on board DDR; integrated BMC; Crypto Disabled
900-9D3B4-00CV-EA0	MT_000001093	NVIDIA BlueField-3 B3220L E-Series FHHL DPU; 200GbE (default mode) / NDR200 IB; Dual-port QSFP112; PCIe Gen5.0 x16; 8 Arm cores; 16GB on-board DDR; integrated BMC; Crypto Enabled
900-9D3B6-00SC-EA0	MT_000001117	NVIDIA BlueField-3 B3210E E-Series FHHL DPU; 100GbE (default mode) / HDR100 IB; Dual-port QSFP112; PCIe Gen5.0 x16 with x16 PCIe extension option; 16 Arm cores; 32GB on-board DDR; integrated BMC; Crypto Disabled
900-9D3B6-00SN-AB0	MT_000000964	NVIDIA BlueField-3 B3240 P-Series Dual-slot FHHL DPU; 400GbE / NDR IB (default mode); Dual-port QSFP112; PCIe Gen5.0 x16 with x16 PCIe extension option; 16 Arm cores; 32GB on-board DDR; integrated BMC; Crypto Disabled
900-9D3B4-00CC-EA0	MT_000000966	NVIDIA BlueField-3 B3210L E-series FHHL DPU; 100GbE (default mode) / HDR100 IB; Dual port QSFP112; PCIe Gen4.0 x16; 8 Arm cores; 16GB on-board DDR; integrated BMC; Crypto Enabled
900-9D3B4-00PN-EA0	MT_000001011	NVIDIA BlueField-3 B3140L E-Series FHHL DPU; 400GbE / NDR IB (default mode); Single-port QSFP112; PCIe Gen5.0 x16; 8 Arm cores; 16GB on-board DDR; integrated BMC; Crypto Disabled
900-9D3B6-	MT_00000	NVIDIA BlueField-3 B3210 P-Series FHHL DPU; 100GbE (default mode) / HDR100 IB; Dual-port QSFP112; PCIe Gen5.0 x16 with x16

<b>SKU</b>	<b>PSID</b>	<b>Description</b>
00CC-AA0	1024	PCIe extension option; 16 Arm cores; 32GB on-board DDR; integrated BMC; Crypto Enabled
900-9D3B6-00SC-AA0	MT_00000 1025	NVIDIA BlueField-3 B3210 P-Series FHHL DPU; 100GbE (default mode) / HDR100 IB; Dual-port QSFP112; PCIe Gen5.0 x16 with x16 PCIe extension option; 16 Arm cores; 32GB on-board DDR; integrated BMC; Crypto Disabled
900-9D3D4-00EN-HA0 / 900-9D3D4-00EN-HAQ	MT_00000 1069	Nvidia BlueField-3 B3140H E-series HHHL DPU; 400GbE(default mode)/NDR IB; Single-port QSFP112; PCIe Gen5.0 x16; 8 Arm cores; 16GB on board DDR; integrated BMC; Crypto Enabled
900-9D3B4-00SC-EA0	MT_00000 0967	NVIDIA BlueField-3 B3210L E-series FHHL DPU; 100GbE (default mode) / HDR100 IB; Dual port QSFP112; PCIe Gen4.0 x16; 8 Arm cores; 16GB on-board DDR; integrated BMC; Crypto Disabled
900-9D3D4-03EN-HA0	MT_00000 1125	HPE Data Processing Unit InfiniBand NDR/Ethernet 400Gb 1-port QSFP112 HHHL B3140H Adapter
699-21014-0230	NVD00000 0038	NVIDIA A800T WITH BLUEFIELD-3; P1014 SKU 230; GENERIC; GA100 80GB HBM2E; PASSIVE DUAL SLOT 350W GEN5; DPU CRYPTO ON
900-9D3B4-00EN-EA0	MT_00000 1010	NVIDIA BlueField-3 B3140L E-Series FHHL DPU; 400GbE / NDR IB (default mode); Single-port QSFP112; PCIe Gen5.0 x16; 8 Arm cores; 16GB on-board DDR; integrated BMC; Crypto Enabled
900-9D3B4-00SV-EA0	MT_00000 1094	NVIDIA BlueField-3 B3220L E-Series FHHL DPU; 200GbE (default mode) / NDR200 IB; Dual-port QSFP112; PCIe Gen5.0 x16; 8 Arm cores; 16GB on-board DDR; integrated BMC; Crypto Disabled
900-9D3C6-00SV-GA0	MT_00000 1101	NVIDIA BlueField-3 B3220SH E-Series No Heatsink FHHL Storage Controller; 200GbE (default mode) / NDR200 IB; Dual-port QSFP112; PCIe Gen5.0 x16 with x16 PCIe extension option; 16 Arm cores; 48GB on-board DDR; integrated BMC; Crypto Disabled
900-9D3C6-00SV-DA0	MT_00000 1102	NVIDIA BlueField-3 B3220SH E-Series FHHL Storage Controller; 200GbE (default mode) / NDR200 IB; Dual-port QSFP112; PCIe

<b>SKU</b>	<b>PSID</b>	<b>Description</b>
		Gen5.0 x16 with x16 PCIe extension option; 16 Arm cores; 48GB on-board DDR; integrated BMC; Crypto Disabled;
900-9D3B6-00CV-AA0	MT_000000884	NVIDIA BlueField-3 B3220 P-Series FHHL DPU; 200GbE (default mode) / NDR200 IB; Dual-port QSFP112; PCIe Gen5.0 x16 with x16 PCIe extension option; 16 Arm cores; 32GB on-board DDR; integrated BMC; Crypto Enabled
900-9D3B6-00SV-AA0	MT_000000965	NVIDIA BlueField-3 B3220 P-Series FHHL DPU; 200GbE (default mode) / NDR200 IB; Dual-port QSFP112; PCIe Gen5.0 x16 with x16 PCIe extension option; 16 Arm cores; 32GB on-board DDR; integrated BMC; Crypto Disabled
900-9D3B6-H1CN-AB0	MT_000000883	NVIDIA BlueField-3 B3240 P-Series Dual-slot FHHL DPU; 400GbE / NDR IB (default mode); Dual-port QSFP112; PCIe Gen5.0 x16 with x16 PCIe extension option; 16 Arm cores; 32GB on-board DDR; integrated BMC; Crypto Enabled
900-9D3C6-00CV-DA0	MT_0000001075	NVIDIA BlueField-3 B3220SH E-Series FHHL Storage Controller; 200GbE (default mode) / NDR200 IB; Dual-port QSFP112; PCIe Gen5.0 x16 with x16 PCIe extension option; 16 Arm cores; 48GB on-board DDR; integrated BMC; Crypto Enabled; Secure Boot
900-9D3C6-00CV-GA0	MT_0000001083	NVIDIA BlueField-3 B3220SH E-Series No heatsink FHHL Storage Controller; 200GbE (default mode) / NDR200 IB; Dual-port QSFP112; PCIe Gen5.0 x16 with x16 PCIe extension option; 16 Arm cores; 48GB on-board DDR; integrated BMC; Crypto Enabled
900-9D3B6-00CC-EA0	MT_0000001115	NVIDIA BlueField-3 B3210E E-Series FHHL DPU; 100GbE (default mode) / HDR100 IB; Dual-port QSFP112; PCIe Gen5.0 x16 with x16 PCIe extension option; 16 Arm cores; 32GB on-board DDR; integrated BMC; Crypto Enabled
900-9D3B4-00EN-EAS	MT_0000001029	NVIDIA BlueField-3 BF3140L E-series SuperNIC NDR/400GbE single port QSFP112; PCIe Gen5.0 x16 FHHL; Crypto Enabled; 16GB on board DDR; integrated BMC; Tall Bracket; IPN QP

## Supported NVIDIA BlueField-2 DPU Platforms

NVIDIA SKU	Legacy OPNs	PSID	Description
900-9D219-0056-SN1	MBF2M 516A-CENOT	MT_000000560	BlueField-2 E-Series DPU 100GbE Dual-Port QSFP56; PCIe Gen4 x16; Crypto Disabled; 16GB on-board DDR; 1GbE OOB management; FHHL
900-9D218-0073-ST0	MBF2H 532C-AESOT	MT_000000766	BlueField-2 P-Series DPU 25GbE Dual-Port SFP56; integrated BMC; PCIe Gen4 x8; Secure Boot Enabled; Crypto Disabled; 32GB on-board DDR; 1GbE OOB management; FHHL
900-9D219-0086-ST1	MBF2M 516A-CECOT	MT_000000375	BlueField-2 E-Series DPU 100GbE Dual-Port QSFP56; PCIe Gen4 x16; Crypto and Secure Boot Enabled; 16GB on-board DDR; 1GbE OOB management; FHHL
900-9D208-0076-ST2	MBF2H 516C-EESOT	MT_000000737	BlueField-2 P-Series DPU 100GbE/EDR/HDR100 VPI Dual-Port QSFP56; integrated BMC; PCIe Gen4 x16; Secure Boot Enabled; Crypto Disabled; 16GB on-board DDR; 1GbE OOB management; Tall Bracket; FHHL
900-9D208-0076-STA	MBF2H 516C-CEUOT	MT_000000973	BlueField-2 P-Series DPU 100GbE Dual-Port QSFP56; integrated BMC; PCIe Gen4 x16; Secure Boot Enabled with UEFI disabled; Crypto Disabled; 16GB on-board DDR; 1GbE OOB management
900-9D208-0086-ST4	MBF2M 516C-EECOT	MT_000000728	BlueField-2 E-Series DPU 100GbE/EDR/HDR100 VPI Dual-Port QSFP56; integrated BMC; PCIe Gen4 x16; Secure Boot Enabled; Crypto Enabled; 16GB on-board DDR; 1GbE OOB management; Tall Bracket; FHHL
900-9D208-0086-ST2	MBF2H 536C-CECOT	MT_000000768	BlueField-2 P-Series DPU 100GbE Dual-Port QSFP56; integrated BMC; PCIe Gen4 x16; Secure Boot Enabled; Crypto Enabled; 32GB on-board DDR; 1GbE OOB management; FHHL
900-9D206-0063-ST1	MBF2H 322A-AEEOT	MT_000000543	BlueField-2 P-Series DPU 25GbE Dual-Port SFP56; PCIe Gen4 x8; Crypto Enabled; 8GB on-board DDR; 1GbE OOB management; HHHL
900-9D250-	MBF2M 345A-	MT_00000	BlueField-2 E-Series DPU; 200GbE/HDR single-port QSFP56; PCIe Gen4 x16; Secure Boot Enabled; Crypto Enabled; 16GB

NVIDIA SKU	Legacy OPNs	PSID	Description
0048-ST1	HECOT	00716	on-board DDR; 1GbE OOB management; HHHL
900-9D218-0083-ST2	MBF2H 512C-AECOT	MT_000000724	BlueField-2 P-Series DPU 25GbE Dual-Port SFP56; integrated BMC; PCIe Gen4 x8; Secure Boot Enabled; Crypto Enabled; 16GB on-board DDR; 1GbE OOB management; FHHL
900-9D208-0086-SQ0	MBF2H 516C-CECOT	MT_000000729	BlueField-2 P-Series DPU 100GbE Dual-Port QSFP56; integrated BMC; PCIe Gen4 x16; Secure Boot Enabled; Crypto Enabled; 16GB on-board DDR; 1GbE OOB management; Tall Bracket; FHHL
900-9D208-0076-ST5	MBF2M 516C-CESOT	MT_000000731	BlueField-2 E-Series DPU 100GbE Dual-Port QSFP56; integrated BMC; PCIe Gen4 x16; Secure Boot Enabled; Crypto Disabled; 16GB on-board DDR; 1GbE OOB management; Tall Bracket; FHHL
900-9D208-0076-ST3	MBF2H 536C-CESOT	MT_000000767	BlueField-2 P-Series DPU 100GbE Dual-Port QSFP56; integrated BMC; PCIe Gen4 x16; Secure Boot Enabled; Crypto Disabled; 32GB on-board DDR; 1GbE OOB management; FHHL
699140280000	N/A	NVD000000020	ZAM/NAS
900-9D219-0066-ST2	MBF2M 516A-CEEOT	MT_000000561	BlueField-2 E-Series DPU 100GbE Dual-Port QSFP56; PCIe Gen4 x16; Crypto Enabled; 16GB on-board DDR; 1GbE OOB management; FHHL
900-9D219-0086-ST0	MBF2M 516A-EECOT	MT_000000376	BlueField-2 E-Series DPU 100GbE/EDR/HDR100 VPI Dual-Port QSFP56; PCIe Gen4 x16; Crypto and Secure Boot Enabled; 16GB on-board DDR; 1GbE OOB management; FHHL
900-9D206-0053-SQ0	MBF2H 332A-AENOT	MT_000000539	BlueField-2 P-Series DPU 25GbE Dual-Port SFP56; PCIe Gen4 x8; Crypto Disabled; 16GB on-board DDR; 1GbE OOB management; HHHL

NVIDIA SKU	Legacy OPNs	PSID	Description
900-9D219-0006-ST0	MBF2H 516A-CEEOT	MT_000000702	BlueField-2 DPU 100GbE Dual-Port QSFP56; PCIe Gen4 x16; Crypto; 16GB on-board DDR; 1GbE OOB management; FHHL
900-9D219-0056-ST2	MBF2H 516A-CENOT	MT_000000703	BlueField-2 DPU 100GbE Dual-Port QSFP56; PCIe Gen4 x16; Crypto Disabled; 16GB on-board DDR; 1GbE OOB management; FHHL
900-9D219-0066-ST3	MBF2H 516A-EEEOT	MT_000000704	BlueField-2 DPU 100GbE/EDR/HDR100 VPI Dual-Port QSFP56; PCIe Gen4 x16; Crypto Enabled; 16GB on-board DDR; 1GbE OOB management; FHHL
900-9D218-0073-ST1	MBF2H 512C-AESOT	MT_000000723	BlueField-2 P-Series DPU 25GbE Dual-Port SFP56; integrated BMC; PCIe Gen4 x8; Secure Boot Enabled; Crypto Disabled; 16GB on-board DDR; 1GbE OOB management; FHHL
900-9D208-0076-ST6	MBF2M 516C-EESOT	MT_000000732	BlueField-2 E-Series DPU 100GbE/EDR/HDR100 VPI Dual-Port QSFP56; integrated BMC; PCIe Gen4 x16; Secure Boot Enabled; Crypto Disabled; 16GB on-board DDR; 1GbE OOB management; Tall Bracket; FHHL
900-9D208-0086-ST3	MBF2M 516C-CECOT	MT_000000733	BlueField-2 E-Series DPU 100GbE Dual-Port QSFP56; integrated BMC; PCIe Gen4 x16; Secure Boot Enabled; Crypto Enabled; 16GB on-board DDR; 1GbE OOB management; Tall Bracket; FHHL
900-9D218-0083-ST4	MBF2H 532C-AECOT	MT_000000765	BlueField-2 P-Series DPU 25GbE Dual-Port SFP56; integrated BMC; PCIe Gen4 x8; Secure Boot Enabled; Crypto Enabled; 32GB on-board DDR; 1GbE OOB management; FHHL
P1004 / 6992100 40230	N/A	NVD000000015	ROY BlueField-2 + GA100 PCIe Gen4 x8; two 100GbE/EDR QSFP28 ports; FHFL
900-9D219-	MBF2M 516A-	MT_0000	BlueField-2 E-Series DPU 100GbE/EDR/HDR100 VPI Dual-Port QSFP56; PCIe Gen4 x16; Crypto Disabled; 16GB on-

NVIDIA SKU	Legacy OPNs	PSID	Description
0056-ST1	EENOT	00377	board DDR; 1GbE OOB management; FHHL
900-9D206-0063-ST2	MBF2H332A-AEEOT	MT_000000540	BlueField-2 P-Series DPU 25GbE Dual-Port SFP56; PCIe Gen4 x8; Crypto Enabled; 16GB on-board DDR; 1GbE OOB management; HHHL
900-9D206-0053-ST2	MBF2H322A-AENOT	MT_000000544	BlueField-2 P-Series DPU 25GbE Dual-Port SFP56; PCIe Gen4 x8; Crypto Disabled; 8GB on-board DDR; 1GbE OOB management; HHHL
900-9D219-0066-ST0	MBF2M516A-EEEOT	MT_000000559	BlueField-2 E-Series DPU 100GbE/EDR/HDR100 VPI Dual-Port QSFP56; PCIe Gen4 x16; Crypto Enabled; 16GB on-board DDR; 1GbE OOB management; FHHL
900-9D208-0076-ST1	MBF2H516C-CESOT	MT_000000738	BlueField-2 P-Series DPU 100GbE Dual-Port QSFP56; integrated BMC; PCIe Gen4 x16; Secure Boot Enabled; Crypto Disabled; 16GB on-board DDR; 1GbE OOB management; Tall Bracket; FHHL
900-9D206-0083-ST3	MBF2H332A-AECOT	MT_000000541	BlueField-2 P-Series DPU 25GbE Dual-Port SFP56; PCIe Gen4 x8; Crypto and Secure Boot Enabled; 16GB on-board DDR; 1GbE OOB management; HHHL
900-9D219-0056-SQ0	MBF2H516A-EENOT	MT_000000705	BlueField-2 DPU 100GbE/EDR/HDR100 VPI Dual-Port QSFP56; PCIe Gen4 x16; Crypto Disabled; 16GB on-board DDR; 1GbE OOB management; FHHL
900-9D250-0038-ST1	MBF2M345A-HESOT	MT_000000715	BlueField-2 E-Series DPU; 200GbE/HDR single-port QSFP56; PCIe Gen4 x16; Secure Boot Enabled; Crypto Disabled; 16GB on-board DDR; 1GbE OOB management; HHHL
900-9D218-0073-ST4	MBF2H512C-AEUOT	MT_000000972	BlueField-2 P-Series DPU 25GbE Dual-Port SFP56; integrated BMC; PCIe Gen4 x8; Secure Boot Enabled with UEFI disabled; Crypto Disabled; 16GB on-board DDR; 1GbE OOB management

NVIDIA SKU	Legacy OPNs	PSID	Description
900-9D208-0076-STB	MBF2H 536C-CEUOT	MT_000001008	BlueField-2 P-Series DPU 100GbE Dual-Port QSFP56; integrated BMC; PCIe Gen4 x16; Secure Boot Enabled with UEFI Disabled; Crypto Disabled; 32GB on-board DDR; 1GbE OOB management; FHHL
900-9D206-0083-ST1	MBF2H 322A-AECOT	MT_000000542	BlueField-2 P-Series DPU 25GbE Dual-Port SFP56; PCIe Gen4 x8; Crypto and Secure Boot Enabled; 8GB on-board DDR; 1GbE OOB management; HHHL
900-9D206-0063-ST4	MBF2M 322A-AEEOT	MT_000000490	BlueField-2 E-Series DPU 25GbE Dual-Port SFP56; PCIe Gen4 x8; Crypto Enabled; 8GB on-board DDR; 1GbE OOB management; HHHL

## Embedded Software

The BlueField DPU installation DOCA local repo package for DPU for this release is DOCA\_2.7.0\_BSP\_4.7.0\_Ubuntu\_22.04-2.23-07.prod.bfb.

The following software components are embedded in it:

Component	Version	Description
ATF	<a href="#">v2.2(release): 4.7.0-25-g5569834</a>	Arm-trusted firmware is a reference implementation of secure world software for Arm architectures
UEFI	<a href="#">4.7.0-42-g13081ae</a>	UEFI is a specification that defines the architecture of the platform firmware used for booting and its interface for interaction with the operating system
BlueField-3 NIC firmware	<a href="#">32.41.1000</a>	Firmware is used to run user programs on the BlueField-3 which allow hardware to run
BlueField-2 NIC firmware	<a href="#">24.41.1000</a>	Firmware is used to run user programs on the BlueField-2 which allow hardware to run

Component	Version	Description
BMC firmware	<a href="#">24.04</a>	BlueField BMC firmware
BlueField-3 eROT (Glacier)	cec_ota_BMG P-04.0f	BlueField-3 eROT firmware
BlueField-2 eROT (CEC)	00.02.0182.000.n02	BlueField-2 eROT firmware

### Info

For more information about embedded software components and drivers, refer to the [DOCA Release Notes](#).

## Supported DPU Linux Distributions (aarch64)

- Ubuntu 22.04

## Supported Host OS per DOCA-Host Installation Profile

The default operating system included with the BlueField Bundle (for DPU and SuperNIC) is Ubuntu 22.04.

The supported operating systems on the host machine per DOCA-Host installation profile are the following:

### Note

Only the following generic kernel versions are supported for DOCA local repo package for host installation.

OS	OS Version	Default Kernel Version	Arch	doca-all	doca-networking	doca-ofed
Alinux	3.2	5.10.134-13.al8.x86_64	x86			
Anolis	8.6	5.10.134+	aarch64			
			x86			
BCLinux	21.10S P2	4.19.90-2107.6.0.0098.oe1.bclinux.aarch64	aarch64			
		4.19.90-2107.6.0.0100.oe1.bclinux.x86_64	x86			
CTYunOS	2.0	4.19.90-2102.2.0.0062.ctl2.aarch64	aarch64			
		4.19.90-2102.2.0.0062.ctl2.x86_64	x86			
	3.0 (23.01)	5.10.0-136.12.0.86.ctl3.aarch64	aarch64			
		5.10.0-136.12.0.86.ctl3.x86_64	x86			
Debian	10.13	4.19.0-21-arm64	aarch64			
		4.19.0-21-amd64	x86			
	10.8	4.19.0-14-arm64	aarch64			
		4.19.0-14-amd64	x86			
	10.9	4.19.0-16-amd64	x86			
	11.3	5.10.0-13-arm64	aarch64			
		5.10.0-13-amd64	x86			
	12.1	6.1.0-10-arm64	aarch64			

OS	OS Version	Default Kernel Version	Arch	doca-all	doca-networking	doca-ofed
		6.1.0-10-amd64	x86			
EulerOS	2.0sp1 1	5.10.0- 60.18.0.50.h323.eulerosv2r11.a arch64	aarch 64			
		5.10.0- 60.18.0.50.h323.eulerosv2r11.x 86_64	x86			
	2.0sp1 2	5.10.0- 136.12.0.86.h1032.eulerosv2r1 2.aarch64	aarch 64			
		5.10.0- 136.12.0.86.h1032.eulerosv2r1 2.x86_64	x86			
Kylin	10sp2	4.19.90- 24.4.v2101.ky10.aarch64	aarch 64			
		4.19.90-24.4.v2101.ky10.x86_64	x86			
	10sp3	4.19.90- 52.22.v2207.ky10.aarch64	aarch 64			
		4.19.90- 52.22.v2207.ky10.x86_64	x86			
Mariner	2.0	5.15.118.1-1.cm2.x86_64	x86			
Oracle Linux	7.9	5.4.17-2011.6.2.el7uek.x86_64	x86			
	8.4	5.4.17- 2102.2013.el8uek.x86_64	x86			
	8.6	5.4.17- 2136.307.3.1.el8uek.x86_64	x86			
	8.7	5.15.0-3.60.5.1.el8uek.x86_64	x86			
	8.8	5.15.0- 101.103.2.1.el8uek.x86_64	x86			
	9.1	5.15.0-3.60.5.1.el9uek.x86_64	x86			

OS	OS Version	Default Kernel Version	Arch	doca-all	doca-networking	doca-ofed
	9.2	5.15.0-101.103.2.1.el9uek.x86_64	x86			
openEuler	20.03s p3	4.19.90-2112.8.0.0131.oe1.aarch64	aarch64			
		4.19.90-2112.8.0.0131.oe1.x86_64	x86			
	22.03	5.10.0-60.18.0.50.oe2203.aarch64	aarch64			
		5.10.0-60.18.0.50.oe2203.x86_64	x86			
	8.0	4.18.0-80.el8.aarch64	aarch64			
		4.18.0-80.el8.x86_64	x86			
RHEL/CentOS	8.1	4.18.0-147.el8.aarch64	aarch64			
		4.18.0-147.el8.x86_64	x86			
	8.2	4.18.0-193.el8.aarch64	aarch64			
		4.18.0-193.el8.x86_64	x86			
	8.3	4.18.0-240.el8.aarch64	aarch64			
		4.18.0-240.el8.x86_64	x86			
	8.4	4.18.0-305.el8.aarch64	aarch64			
		4.18.0-305.el8.x86_64	x86			
	8.5	4.18.0-348.el8.aarch64	aarch64			
		4.18.0-348.el8.x86_64	x86			

OS	OS Version	Default Kernel Version	Arch	doca-all	doca-networking	doca-ofed
	8.6	4.18.0-372.41.1.el8_6.aarch64	aarch64			
		4.18.0-372.41.1.el8_6.x86_64	x86			
	8.7	4.18.0-425.14.1.el8_7.aarch64	aarch64			
		4.18.0-425.14.1.el8_7.x86_64	x86			
	8.8	4.18.0-477.10.1.el8_8.aarch64	aarch64			
		4.18.0-477.10.1.el8_8.x86_64	x86			
	8.9	4.18.0-513.5.1.el8_9.aarch64	aarch64			
		4.18.0-513.5.1.el8_9.x86_64	x86			
	9.0	5.14.0-70.46.1.el9_0.aarch64	aarch64			
		5.14.0-70.46.1.el9_0.x86_64	x86			
	9.1	5.14.0-162.19.1.el9_1.aarch64	aarch64			
		5.14.0-162.19.1.el9_1.x86_64	x86			
	9.2	5.14.0-284.11.1.el9_2.aarch64	aarch64			
		5.14.0-284.11.1.el9_2.x86_64	x86			
	9.3	5.14.0-362.8.1.el9_3.aarch64	aarch64			
		5.14.0-362.8.1.el9_3.x86_64	x86			
SLES	15sp2	5.3.18-22-default	aarch64			
			x86			
	15sp3	5.3.18-57-default	aarch64			

OS	OS Version	Default Kernel Version	Arch	doca-all	doca-networking	doca-ofed
	15sp4	5.14.21-150400.22-default	x86			
			aarch64			
	15sp5	5.14.21-150500.53-default	x86			
			aarch64			
TCLinux	3.3	5.4.119-19.0009.39	aarch64			
		5.4.119-19.0009.39	x86			
Ubuntu	20.04	5.4.0-26-generic	aarch64			
			x86			
	22.04	5.15.0-25-generic	aarch64			
			x86			
	24.04	6.8.0-31-generic	aarch64			
			x86			
UOS	20.1060a	5.10.0-46.uelc20.aarch64	aarch64			
		5.10.0-46.uelc20.x86_64	x86			
	20.1060e	5.10.0-46.uel20.aarch64	aarch64			
		5.10.0-46.uel20.x86_64	x86			

## Supported Open vSwitch

- 2.15.1

## Bug Fixes In This Version

### Info

For an archive of bug fixes from previous releases, please see "[Bug Fixes History](#)".

Ref #	Issue Description
381	Description: Kubernetes official repository changed location and it causes apt/yum failures on the BlueField OSes older than BSP 4.7.0 (DOCA 2.7.0).
452 6	Keywords: Kubernetes; OS Reported in version: 4.6.0
381 452 6	Description: The location of the official Kubernetes repository changed, causing apt/yum failures. Keywords: Kubernetes Reported in version: 4.6.0
382 066 1	Description: Virtio-net may see TX timeout on specific queues. Keywords: Emulated devices Reported in version: 4.6.0
385 045 9	Description: BMC components update fails while using default BMC root password. Keywords: BMC; update Reported in version: 4.6.0
377 408 8	Description: When enrolling a certificate to the UEFI DB, the failure message "ERROR: Unsupported file type!" is displayed when the DB was full.

Ref #	Issue Description
	<p>Keywords: SNAP; UEFI; error</p> <p>Reported in version: 4.5.0</p>
378	<p>Description: Host PCIe driver hangs when hot plugging a device due to SF creation and error flow handling failure.</p>
700 3	<p>Keywords: Subfunction; hot-plug</p> <p>Reported in version: 4.5.0</p>
366	<p>Description: On rare occasions, OP-TEE may panic upon boot.</p>
339 8	<p>Keywords: fTPM over OP-TEE</p> <p>Reported in version: 4.5.0</p>
367 736 6	<p>Description: On rare occasions, the devices /dev/tpm0 and /dev/tpmrm0 are not created triggering an fTPM panic during boot. This message indicates that the fTPM over OP-TEE feature is not functional.</p> <p>Keywords: fTPM over OP-TEE</p> <p>Reported in version: 4.5.0</p>
371 291 6	<p>Description: The following fTPM over OP-TEE error appears when booting BlueField:</p> <pre>ftpm-tee PRP0001:01: ftpm_tee_probe: tee_client_open_session failed, err=ffff3024</pre> <p>Keywords: fTPM over OP-TEE</p> <p>Reported in version: 4.5.0</p>
383 003 4	<p>Description: The following bfscripts have been deprecated and may no longer work as expected: bfinst, bfdracut, bfacpievt. These scripts are no longer supported and will eventually be removed. Warning logs have been added to notify users.</p> <p>Keywords: Deprecated bfscripts</p> <p>Reported in version: 4.5.0</p>
361 893	<p>Description: When moving to DPU mode from NIC mode, it is necessary to reinstall the BFB and perform a graceful reboot to the DPU by shutting down the Arm cores</p>

Ref #	Issue Description
6	before rebooting the host system. Keywords: NIC mode Reported in version: 4.2.2
	Description: Running mlxfwreset on BlueField-3 may cause the external host to crash when the RShim driver is running on that host.
	Keywords: RShim; mlxfwreset Reported in version: 4.2.1
344 407 3	Description: mlxfwreset is not supported in this release. Keywords: mlxfwreset; support Reported in version: 4.0.2

## Known Issues

Ref #	Issue
32 39 32 0	Description: Resetting hugepage size to 0 on Rocky Linux 8.6 using the sysctl tool fails. Workaround: Use the following command instead: <pre>echo 0 &gt; /sys/kernel/mm/hugepages/hugepages-&lt;Size&gt;/nr_hugepages</pre>
	Keyword: Hugepage; sysctl
	Reported in version: 4.7.0
	Description: Reloading MLNX_OFED drivers with the command /etc/init.d/openibd restart fails when the NVMe driver is installed and in use.
59 11 3	Workaround: Reboot the machine to load all the MLNX_OFED drivers.
	Keyword: NVMe; driver
	Reported in version: 4.7.0

Ref #	Issue
37	Description: With the numbering of CPUs in an 8-core configuration, the kernel is expected to assign virtual CPU ID numbers from 0-7, where N is the number of cores enabled. With CTyunOS, however, the numbering is unexpected.
48	Workaround: N/A
64	Keyword: CTyunOS; CPU numbering
9	Reported in version: 4.7.0
37	Description: When performing BFB push repeatedly, BlueField-3 may in rare instances fail to boot with the message "PSC error -60" appearing in the RShim log sometimes.
56	Workaround: Reset the card or repeat the operation (bfb push).
74	Keyword: BFB Push; FW Reset
8	Reported in version: 4.7.0
38	Description: In OpenEuler 20.03, the Linux Kernel version 4.19.90 is affected by an issue that impacts the discard/trim functionality for the BlueField's eMMC which may cause degraded performance of the eMMC over time.
31	Workaround: Upgrade to Linux Kernel version 5.10 or later.
23	Keyword: eMMC discard; trim functionality
0	Reported in version: 4.7.0
36	Description: Virtio-net controller fails to load if DPA_AUTHENTICATION is enabled.
65	Workaround: N/A
07	Keyword: Virtio-net; DPA
0	Reported in version: 4.7.0
38	Description: Creating VFs and hotplug PFs in parallel can lead to controller crash.
62	Workaround: Create VFs followed by hotplug PF or vice versa.
68	Keyword: Virtio-net emulation
3	Reported in version: 4.7.0

Ref #	Issue
38 44 06 6	<p>Description: On CentOS 7.6 with kernel 4.19, bringing up OVS bridge interface causes call traces:          WARNING: CPU: 5 PID: 14339 at kernel/rcu/tree_plugin.h:342 rcu_note_context_switch+0x48/0x538</p> <p>Workaround: Do not bring UP OVS bridge interfaces.</p> <p>Keyword: CentOS; kernel; rcu_note_context_switch</p> <p>Reported in version: 4.7.0</p>
38 86 31 5	<p>Description: To reset or shut down the BlueField Arm, it is mandatory to specify the --sync 0 argument. For example:</p> <pre>mlxfwreset -d &lt;device&gt; -l 1 -t 4 --sync 0 r</pre> <p>Workaround: N/A</p> <p>Keyword: Arm; shutdown</p> <p>Reported in version: 4.7.0</p>
38 81 94 1	<p>Description: When working with RShim 2.0.28, PCIe host crash may rarely occur at the beginning of BFB push after the Arm reset.</p> <p>Workaround: Downgrade to RShim 2.0.27 or upgrade to RShim 2.0.29.</p> <p>Keyword: RShim; driver</p> <p>Reported in version: 4.7.0</p>
38 44 70 5	<p>Description: In OpenEuler 20.03, the Linux Kernel version 4.19.90 is affected by an issue that impacts the discard/trim functionality for the DPU eMMC device which may cause degraded performance of the DPU eMMC over time.</p> <p>Workaround: Upgrade to Linux Kernel version 5.10 or later.</p> <p>Keyword: eMMC discard; trim functionality</p> <p>Reported in version: 4.7.0</p>
38 77 72 5	<p>Description: During BFB installation in NIC mode on BlueField-3, too much information is added into RShim log which fills it, causing the Linux installation progress log to not appear in the RShim log.</p> <pre>echo "DISPLAY_LEVEL 2" &gt; /dev/rshim0/misc</pre>

Ref #	Issue
	<p>cat /dev/rshim0/misc</p> <p>Workaround: Monitor the BlueField-3 Arm's UART console to check whether BFB installation has completed or not for NIC mode.</p> <pre>[13:58:39] INFO: Installation finished ... [14:01:53] INFO: Rebooting...</pre> <p>Keyword: NIC mode; BFB install</p> <p>Reported in version: 4.7.0</p>
	<p>Description: After the BFB installation, the root partition UUID in /etc/fstab does not match current partition UUID. As a result root partition is mounted as read-only: /dev/nvme0n1p2 on / type xfs (ro,relatime,attr2,inode64,logbufs=8,logbsize=32k,noquota)</p> <p>Workaround:</p> <ol style="list-style-type: none"> <li>1. Fix root partition UUID in the /etc/fstab:</li> </ol> <pre>mount -o remount,rw /dev/nvme0n1p2 /</pre> <ol style="list-style-type: none"> <li>2. Get UUID:</li> </ol> <pre># lsblk -o UUID /dev/nvme0n1p2 UUID ae1d5e37-7aee-4234-984b-9a9203bfd182</pre> <ol style="list-style-type: none"> <li>3. Update UUID in the /etc/fstab to match the one printed by lsblk:</li> </ol> <pre>UUID=ae1d5e37-7aee-4234-984b-9a9203bfd182 / xfs defaults 0 1</pre> <p>Keyword: Read-only; OL; UUID</p> <p>Reported in version: 4.7.0</p>
38 75 39 4	<p>Description: Trying to jump from a steering level in the hardware to a lower level using software steering is not supported on rdma-core lower than 48.x.</p>

Ref #	Issue
70 2	<p>Workaround: N/A</p> <p>Keyword: RDMA; SWS</p> <p>Reported in version: 4.7.0</p>
38 44 70 5	<p>Description: In OpenEuler 20.03, the Linux Kernel version 4.19.90 is affected by a bug that impacts the discard/trim functionality for the DPU eMMC device which may cause degraded performance of the DPU eMMC over time.</p> <p>Workaround: Upgrade to Linux Kernel version 5.10 or later.</p> <p>Keyword: eMMC discard; trim functionality</p> <p>Reported in version: 4.7.0</p>
37 43 87 9	<p>Description: mlxfwreset could timeout on servers where the RShim driver is running and INTx is not supported. The following error message is printed: BF reset flow encountered a failure due to a reset state error of negotiation timeout.</p> <p>Workaround: Set PCIE_HAS_VFIO=0 and PCIE_HAS_UIO=0 in /etc/rshim.conf and restart the RShim driver. Then re-run the mlxfwreset command.</p> <p>If host Linux kernel lockdown is enabled, then manually unbind the RShim driver before mlxfwreset and bind it back after mlxfwreset:</p> <pre>echo "DROP_MODE 1" &gt; /dev/rshim0/misc mlxfwreset &lt;arguments&gt; echo "DROP_MODE 0" &gt; /dev/rshim0/misc</pre> <p>Keyword: Timeout; mlxfwreset; INTx</p> <p>Reported in version: 4.7.0</p>
36 70 36 1 37 46	<p>Description: Rarely, the driver takes more than several minutes to load.</p> <p>Workaround: Re-run /sbin/mlnx_bf_configure.</p> <p>Keywords: Driver; boot</p> <p>Reported in version: 4.6.0</p> <p>Description: The error message IANA PEN registry open failed: No such file or directory may appear when using ipmitool version 1.8.19-7. This message can be safely ignored.</p>

Ref #	Issue
86 6	<p>Workaround: N/A</p> <p>Keywords: IPMI; Debian</p> <p>Reported in version: 4.6.0</p>
37 55 14 3	<p>Description: UEFI synchronous exception is observed at address 0x479B7xxxx where the UEFI module names are not printed. See the following example:</p> <pre>ERR[UEFI]: PC=0x479B78480(B4000040 3900001F A94153F3 F94013F5) ERR[UEFI]: PC=0x479B78480 ERR[UEFI]: PC=0x479B7E684 ERR[UEFI]: PC=0x47A0E93F4 ERR[UEFI]: PC=0x47A0E9608</pre> <p>Workaround: Run software reset or reinstall the BFB.</p> <p>Keywords: UEFI synchronous exception</p> <p>Reported in version: 4.6.0</p>
37 72 17 7	<p>Description: SHHing to the DPU with Debian 12 can print the following warning: - bash: warning: setlocale: LC_ALL: cannot change locale (en_US.UTF-8).</p> <p>Workaround: Run:</p> <pre>sudo dpkg-reconfigure locales</pre> <p>Keywords: Debian 12; locale; LC_ALL</p> <p>Reported in version: 4.6.0</p>
37 04 98 5	<p>Description: When the RShim driver is not running on the external host or when the tmfifo_net0 interface is down on the DPU side, the following kernel warning may appear on the DPU side: virtio_net virtio1 tmfifo_net0: TX timeout.</p> <p>Workaround: N/A</p> <p>Keywords: RShim; log</p> <p>Reported in version: 4.6.0</p>
37 67	<p>Description: On Debian 12, the first boot after BFB installation may fail with the following kernel panic:</p>

Ref #	Issue
580	<p>[ end Kernel panic - not syncing: Attempted to kill init! exitcode=0x00000100 ]</p> <p>Workaround: Reset the DPU using the RShim interface:</p> <pre>echo "SW_RESET 1" &gt; /dev/rshim0/misc</pre> <p>Keywords: Debian 12; Kernel panic; kill init</p> <p>Reported in version: 4.6.0</p>
3771	<p>Description: On Debian 12, /etc/init.d/openibd restart fails with the following error:</p> <pre>rmmmod: ERROR: Module rdma_cm is in use by: nvme_rdma</pre> <p>Workaround: Run:</p> <pre>modprobe -r nvme_rdma; /etc/init.d/openibd restart</pre> <p>Keywords: Debian 12; openibd; nvme_rdma</p> <p>Reported in version: 4.6.0</p>
3686053	<p>Description: BlueField-2 supports a total of 120GB of PCIe memory space. When the GPU is configured to be exposed to the BlueField, it requests 32GB of space for its BAR0. The Linux 5.15 kernel also attempts to reserve space for the total number of VFs, even if they are not enabled. By default, the A100 allows 20 VFs which each need 4GB of memory space. Because of PCIe memory alignment requirements and other small devices on the bus, this additional 80GB causes PCIe resource allocation to fail.</p> <p>Workaround: Add "pci=realloc=off" to the Linux command line. This will force Linux to accept the resource allocation done by UEFI and allow enumeration to succeed.</p> <p>Keyword: VF; kernel; resources</p> <p>Reported in version: 4.6.0</p>
3678069	<p>Description: If using DPUs with NVMe and mmcblk and configured to boot from mmcblk, users must create a bf.cfg file with device=/dev/mmcblk0 before installing the *.fbf.</p> <p>Workaround: N/A</p>

Ref #	Issue
	<p>Keyword: NVMe</p> <p>Reported in version: 4.6.0</p>
37	<p>Description: The ipmitool command to force PXE in BMC modifies both the IPMI and Redfish request settings. When Redfish is enabled in UEFI, Redfish takes priority, so all PXE boot entries are attempted and before regular boot continues.</p>
47	
28	<p>Workaround: Redfish must be disabled if IPMI force PXE retry behavior is expected.</p>
5	<p>Keyword: PXE; retry; fail</p>
	<p>Reported in version: 4.6.0</p>
37	<p>Description: When rebooting the DPU while the host side is running traffic over bond, TX timeout is likely to occur. This generates a TX timeout recovery flow that may conflict with host recovery attempts from the DPU reboot.</p>
45	
52	<p>Workaround: N/A</p>
9	<p>Keyword: Bond; timeout</p>
	<p>Reported in version: 4.6.0</p>
37	<p>Description: CA certificates in the UEFI are stored in the database provided by the user. It is user responsibility to enroll the correct certificate. The user is the owner of the certificate and should make sure of its validity.</p>
33	
71	<p>Workaround: N/A</p>
3	<p>Keyword: CA certificates; UEFI</p>
	<p>Reported in version: 4.6.0</p>
37	<p>Description: CA certificates in the BMC are owned by the user who is required to enroll valid and correct certificates. If incorrect BMC CA certificates are enrolled, then DPU-BMC redfish communication will be invalid.</p>
33	
74	<p>Workaround: N/A</p>
0	<p>Keyword: CA certificates; BMC</p>
	<p>Reported in version: 4.6.0</p>
36	<p>Description: Running systemctl restart openibd on the DPU can result in openvswitch service crash.</p>
66	

Ref #	Issue
57 4	<p>Workaround: Run <code>/etc/init.d/openvswitch-switch start.</code></p> <p>Keyword: OVS fail; openibd</p> <p>Reported in version: 4.6.0</p>
32 32	<p>Description: On BlueField-2, the OOB may not get an IP address due to the interface being down.</p>
04 15 3	<p>Workaround: restart auto-negotiation using the command <code>ethtool -r oob_net0.</code></p> <p>Keyword: OOB; IP</p> <p>Reported in version: 4.5.0</p>
36 01 49 1	<p>Description: Symmetric pause must be enabled in the DHCP server for the OOB to be able to reliably get an IP address assigned.</p> <p>Workaround: N/A</p> <p>Keyword: OOB; IP</p> <p>Reported in version: 4.5.0</p>
36 73 33 0	<p>Description: On Debian 12, Arm ports remain in Legacy mode after multiple Arm reboot iterations. The following error message appears in <code>/var/log/syslog</code>:</p> <pre>mlnx_bf_configure[2601]: ERR: Failed to configure switchdev mode for 0000:03:00.0 after 61 retries</pre> <p>Workaround: Run:</p> <pre>\$ echo SET_MODE_RETRY_NUM=300 &gt;&gt; /etc/mellanox/mlnx-bf.conf \$ reboot</pre> <p>Keyword: Debian; Arm</p> <p>Reported in version: 4.5.0</p>
36 95 54 3	<p>Description: PXE boot may fail after a firmware upgrade from 32.36.xxxx, 32.37.xxxx, to 32.38.xxxx and above.</p> <p>Workaround: Create <code>/etc/bf.cfg</code> with the following lines, then run <code>bfcfg</code> to recreate the PXE boot entries:</p>

Ref #	Issue
	<p>BOOT0=DISK      BOOT1=NET-NIC_P0-IPV4      BOOT2=NET-NIC_P0-IPV6      BOOT3=NET-NIC_P1-IPV4      BOOT4=NET-NIC_P1-IPV6      BOOT5=NET-OOB-IPV4      BOOT6=NET-OOB-IPV6</p>
	<p>Keyword: MAC allocation; PXE boot</p>
	<p>Reported in version: 4.5.0</p>
36	Description: Debian 12 OS does not support CT tunnel offload.
47	Workaround: Recompile the kernel with CONFIG_NET_TC_SKB_EXT set.
47	Keyword: Connection tracking; Linux
6	Reported in version: 4.5.0
30	Description: When configuring a static IP address for tmfifo_net0 interface in /etc/network/interfaces, the IP address is lost after restarting the RShim driver on Debian Linux.
6	Workaround: Use netplan configuration. For example
	<pre># cat /etc/netplan/tmfifo_net0.yaml network:   version: 2   renderer: networkd   ethernets:     tmfifo_net0:       addresses:         - 192.168.100.1/30       dhcp4: false</pre>
	<p>Then run "netplan apply".</p>
	<p>Keyword: IP address; tmfifo_net0; host</p>

Ref #	Issue
	Reported in version: 4.5.0
36	Description: When NIC subsystem is in recovery mode, the interface towards to NVMe is not accessible. Thus, the SSD boot device would not be available.
70	Workaround: The admin must configure the Arm subsystem boot device to boot from the eMMC, for example.
62	
8	Keyword: mlxfwreset; RShim
	Reported in version: 4.5.0
37	Description: On rare occasions, the boot process part of SWRESET (via RShim) or FWRESET (via mlxfwreset) may result in a device hanging on the boot flow or cause the host server to reboot.
02	Workaround: Perform <u>graceful shutdown</u> and then a power cycle.
39	
3	Keyword: mlxfwreset; RShim
	Reported in version: 4.5.0
36	Description: If the UEFI password is an empty string (""), then it cannot be changed via Redfish.
65	Workaround: UEFI; password; Redfish
72	
4	Keyword: UEFI; password; Redfish
	Reported in version: 4.5.0
36	Description: XFRM rules must be deleted before driver restart or warm reboot are performed.
71	Workaround: N/A
18	
5	Keyword: IPsec
	Reported in version: 4.5.0
36	Description: Installing BFB using bfb-install when mlxconfig PF_TOTAL_SF>1700, triggers server reboot immediately.
66	
16	Workaround: Change PF_TOTAL_SF to 0, perform <u>graceful shutdown</u> , then power cycle, and then install the BFB.
0	

Ref #	Issue
	<p>Keyword: SF; PF_TOTAL_SF; BFB installation</p> <p>Reported in version: 4.2.2</p>
36 05 25 4	<p>Description: Following a system power cycle, both the DPU and BMC boot independently which may lead to the DPU's UEFI boot process to complete before the BMC's. As a result, when attempting to establish Redfish communication, the BMC may not yet be prepared to respond.</p> <p>Workaround: Wait until the BMC is done booting before issuing a reset command to the DPU.</p> <p>Keyword: Power cycle; Redfish; boot</p> <p>Reported in version: 4.2.1</p>
36 02 04 4	<p>Description: When the public key is deleted while Redfish is enabled, UEFI secure boot is disabled and UEFI reverts to Setup Mode (i.e., the SecureBootEnable Redfish property is reset to false). If later, the public key is re-enrolled, the platform does not implement UEFI secure boot until the SecureBootEnable Redfish property is explicitly changed to true.</p> <p>Workaround: Set SecureBootEnable to true using the Redfish API.</p> <p>Keyword: Redfish; UEFI secure boot</p> <p>Reported in version: 4.2.1</p>
35 92 08 0	<p>Description: When using UEK8 on the host in DPU mode, creating a VF on the host consumes about 100MB memory on the DPU.</p> <p>Workaround: N/A</p> <p>Keyword: UEK; VF</p> <p>Reported in version: 4.2.1</p>
35 68 34 1	<p>Description: Downgrading BSP software from 4.2.0 fails if UEFI secure boot is enabled.</p> <p>Workaround: Disable UEFI secure boot before downgrading.</p> <p>Keyword: Software; downgrade</p> <p>Reported in version: 4.2.0</p>

Ref #	Issue
35	<p>Description: Virtio hotplug is not supported in GPU-HOST mode on the NVIDIA Converged Accelerator.</p> <p>Workaround: N/A</p> <p>Keyword: Virtio; Converged Accelerator</p> <p>Reported in version: 4.2.0</p>
35	<p>Description: PXE boot over ConnectX interface might not work due to an invalid MAC address in the UEFI boot entry.</p> <p>Workaround: On the DPU, create /etc/bf.cfg file with the relevant PXE boot entries, then run the command bfcfg.</p> <p>Keyword: PXE; boot; MAC</p> <p>Reported in version: 4.2.0</p>
35	<p>Description: After rebooting a BlueField-3 DPU running Rocky Linux 8.6 BFB, the kernel log shows the following error:</p> <pre>[ 3.787135] mlxbf_gige MLNXBF17:00: Error getting PHY irq. Use polling instead</pre> <p>This message indicates that the Ethernet driver will function normally in all aspects, except that PHY polling is enabled.</p> <p>Workaround: N/A</p> <p>Keyword: Linux; PHY; kernel</p> <p>Reported in version: 4.2.0</p>
33 06 48 9	<p>Description: When performing longevity tests (e.g., mlxfwreset, DPU reboot, burning of new BFBs), a host running an Intel CPU may observe errors related to "CPU 0: Machine Check Exception".</p> <p>Workaround: Add intel_idle.max_cstate=1 entry to the kernel command line.</p> <p>Keyword: Longevity; mlxfwreset; DPU reboot</p> <p>Reported in version: 4.2.0</p>
35 38	<p>Description: When removing LAG configuration from the DPU, a kernel warning for</p>

Ref #	Issue
48 6	<p>uverbs_destroy_ufile_hw is observed if virtio-net-controller is still running.</p> <p>Workaround: Stop virtio-net-controller service before cleaning up bond configuration.</p> <p>Keyword: Virtio-net; LAG</p> <p>Reported in version: 4.2.0</p>
34 62	<p>Description: When trying to perform a PXE installation when UEFI Secure Boot is enabled, the following error messages may be observed:</p> <pre>error: shim_lock protocol not found. error: you need to load the kernel first.</pre>
63 0	<p>Workaround: Download a Grub EFI binary <a href="#">from the Ubuntu website</a>. For further information on Ubuntu UEFI Secure Boot PXE Boot, please visit Ubuntu's official website.</p> <p>Keyword: PXE; UEFI Secure Boot</p> <p>Reported in version: 4.0.2</p>
34 12	<p>Description: Socket-Direct is currently not supported on BlueField-3 devices.</p> <p>Workaround: N/A</p>
84 7	<p>Keyword: Socket-Direct; support</p> <p>Reported in version: 4.0.2</p>
34 48 84 1	<p>Description: While running CentOS 8.2, switchdev Ethernet DPU runs in "shared" RDMA net namespace mode instead of "exclusive".</p> <p>Workaround: Use ib_core module parameter netns_mode=0. For example:</p> <pre>echo "options ib_core netns_mode=0" &gt;&gt; /etc/modprobe.d/mlnx-bf.conf</pre> <p>Keywords: RDMA; isolation; Net NS</p> <p>Reported in version: 4.0.2</p>
34 13	<p>Description: Using mlnx-sf script, creating and deleting an SF with same ID number in a stressful manner may cause the setup to hang due to a race between create and delete commands.</p>

Ref #	Issue
938	<p>Workaround: N/A</p> <p>Keywords: Hang; mlx-sf</p> <p>Reported in version: 4.0.2</p>
34	<p>Description: Ovs-pki is not working due to two versions of OpenSSL being installed, causing the PKA engine to not load properly.</p>
52	<p>Workaround: N/A</p>
740	<p>Keywords: PKA; OpenSSL</p>
	<p>Reported in version: 4.0.2</p>
32	<p>Description: Changing the mode of operation between NIC and DPU modes results in different capabilities for the host driver which might cause unexpected behavior.</p>
73	<p>Workaround: Reload the host driver or reboot the host.</p>
435	<p>Keywords: Modes of operation; driver</p>
	<p>Reported in version: 4.0.2</p>
27	<p>Description: When an NVMe controller, SoC management controller, and DMA controller are configured, the maximum number of VFs is limited to 124.</p>
06	<p>Workaround: N/A</p>
803	<p>Keywords: VF; limitation</p>
	<p>Reported in version: 4.0.2</p>
32	<p>Description: When trying to change boot order using efibootmgr, BlueField fails to attempt PXE boot from p0 even though efibootmgr returns a successful result.</p>
64	<p>Workaround: Drop into the UEFI menu and regenerate all the EFI entries.</p>
224	<p>Keywords: PXE; efibootmgr</p>
	<p>Reported in version: 3.9.3.1</p>
3188	<p>Description: An Arm firmware update to the same version that is installed will fail and is not supported.</p>
415	<p>Workaround: N/A</p>

Ref #	Issue
	<p>Keywords: Arm; firmware; update</p> <p>Reported in version: 3.9.2</p>
N/A	<p>Description: The BootOptionEnabled attribute changes back to true after DPU-force reset.</p> <p>Workaround: N/A</p> <p>Keywords: Redfish; BootOptionEnabled</p> <p>Reported in version: 3.9.2</p>
30	<p>Description: The command ethtool -l --show-fec is not supported by the DPU with kernel 5.4.</p>
12	<p>Workaround: N/A</p>
18	<p>Keywords: Kernel; show-fec</p>
2	<p>Reported in version: 3.9.0</p>
28	<p>Description: After disabling SR-IOV VF on a virtio device, removing virtio-net/PCIe driver from guest OS may render the virtio controller unusable .</p>
55	<p>Workaround: Restart the virtio-net controller to recover it. To avoid this issue, monitor the log from controller and make sure VF resources are destroyed before unloading virtio-net/PCIe drivers.</p>
98	<p>Keywords: Virtio-net; VF</p>
6	<p>Reported in version: 3.9.0</p>
28	<p>Description: SA limit by packet count (hard and soft) are supported only on traffic originated from the ECPF. Trying to configure them on VF traffic removes the SA when hard limit is hit. However, traffic could still pass as plain text due to the tunnel offload used in such configuration.</p>
63	<p>Workaround: N/A</p>
45	<p>Keywords: ASAP2; IPsec Full Offload</p>
6	<p>Reported in version: 3.9.0</p>
29	<p>Description: When multiple BlueField resets are issued within 10 seconds of each other, EEPROM error messages are displayed on the console and, as a result, the</p>
82	

Ref #	Issue
18	BlueField may not boot from the eMMC and may halt at the UEFI menu.
4	Workaround: Power-cycle the BlueField to fix the EEPROM issue. Manual recovery of the boot options and/or SW installation may be needed.  Keywords: Reset; EEPROM  Reported in version: 3.9.0
28	Description: Some pre-OS environments may fail when sensing a hot plug operation during their boot stage.
53	Workaround: Run "mlxconfig -d <mst dev> set PF_LOG_BAR_SIZE=0".
40	Keywords: BIOS; hot-plug; Virtio-net
8	Reported in version: 3.9.0
29	Description: Running I/O traffic and toggling both physical ports status in a stressful manner on the receiving-end machine may cause traffic loss.
34	Workaround: N/A
83	Keywords: MLNX_OFED; RDMA; port toggle
3	Reported in version: 3.8.5
29	Description: ProLiant DL385 Gen10 Plus server with BIOS version 1.3 hangs when large number of SFs (PF_TOTAL_SF=252) are configured.
11	Workaround: Update the BIOS version to 2.4 which should correctly detect the PCIe device with the bigger BAR size.
42	Keywords: Scalable functions; BIOS
5	Reported in version: 3.8.5
N/A	Description: Only QP queues are supported for GGA accelerators from this version onward.  Workaround: N/A  Keywords: Firmware; SQ; QP  Reported in version: 3.8.0

Ref #	Issue
28	<p>Description: Setting VHCA_TRUST_LEVEL does not work when there are active SFs or VFs.</p>
46	<p>Workaround: N/A</p>
10	<p>Keywords: Firmware; SF; VF</p>
8	<p>Reported in version: 3.8.0</p>
27	<p>Description: Some devlink commands are only supported by mlx5 devlink (/opt/mellanox/iproute2/sbin/devlink). The default devlink from the OS may produce failure (e.g., devlink port show -j).</p>
50	<p>Workaround: N/A</p>
49	<p>Keywords: Devlink</p>
9	<p>Reported in version: 3.7.1</p>
27	<p>Description: Kernel upgrade is not currently supported on BlueField as there are out of tree kernel modules (e.g., ConnectX drivers that will stop working after kernel upgrade).</p>
30	<p>Workaround: Kernel can be upgraded if there is a matching DOCA repository that includes all the drivers compiled with the new kernel or as a part of the new BFB package.</p>
15	<p>Keywords: Kernel; upgrade</p>
7	<p>Reported in version: 3.7.0</p>
27	<p>Description: Call traces are seen on the host when recreating VFs before the controller side finishes the deletion procedure.</p>
06	<p>Workaround: N/A</p>
71	<p>Keywords: Virtio-net controller</p>
0	<p>Reported in version: 3.7.0</p>
26	<p>Description: 3rd party (netkvm.sys) Virtio-net drivers for Windows do not support SR-IOV.</p>
85	<p>Workaround: N/A</p>
47	<p>Keywords: Virtio-net; SR-IOV; WinOF-2</p>
8	<p>Reported in version: 3.7.0</p>

Ref #	Issue
	Reported in version: 3.7.0
26 84 50	Description: Once the contiguous memory pool, a limited resource, is exhausted, fallback allocation to other methods occurs. This process triggers <code>cma_alloc</code> failures in the dmesg log. Workaround: N/A
1	Keywords: Log; <code>cma_alloc</code> ; memory
	Reported in version: 3.7.0
25 90 01 6	Description: <code>ibdev2netdev</code> tool is not supported for PCIe PF operating in switchdev mode or on SFs. Workaround: N/A Keywords: <code>ibdev2netdev</code>
	Reported in version: 3.6.0.11699
25 90 01 6	Description: A "double free" error is seen when using the "curl" utility. This error is from <code>libcrypto.so</code> library which is part of the OpenSSL package. This happens only when OpenSSL is configured to use a dynamic engine (e.g. Bluefield PKA engine). Workaround: Set <code>OPENSSL_CONF=/etc/ssl/openssl.cnf.orig</code> before using the curl utility. For example:
	<pre># OPENSSL_CONF=/etc/ssl/openssl.cnf.orig curl -O https://tpo.pe/pathogen.vim</pre>
	<p> <b>Note</b></p> <p>OPENSSL_CONF is aimed at using a custom config file for applications. In this case, it is used to point to a config file where dynamic engine (PKA engine) is not enabled.</p>
	Keywords: OpenSSL; curl

Ref #	Issue
	Reported in version: 3.6.0.11699
24 07 89 7	<p>Description: The host may crash when the number of PCIe devices overflows the PCIe device address. According to the PCIe spec, the device address space is 8 bits in total—device (5 bits) and function (3 bits)—which means that the total number of devices cannot be more than 256.</p> <p>The second PF maximum number of VFs is limited by the total number of additional PCIe devices that precedes it. By default, the preceding PCIe devices are 2 PFs + RShim DMA + 127 VFs of the first PF. This means that the maximum valid number of VFs for the second port will be 126.</p>
	<p>Workaround: Use the maximum allowed VFs on the 2nd PCIe PF of BlueField instead of the maximum of 127 VFs.</p> <p>Keywords: Emulated devices; VirtIO-net; VirtIO-blk; VFs; RShim</p>
	Reported in version: 3.6.0.11699
24 45 28 9	<p>Description: If secure boot is enabled, MFT cannot be installed on the BlueField DPU independently from BlueField drivers (MLNX_OFED).</p> <p>Workaround: N/A</p> <p>Keywords: MFT; secure boot</p>
	Reported in version: 3.5.1.11601
23 77 02 1	<p>Description: Executing sudo poweroff on the Arm side causes the system to hang.</p> <p>Workaround: Perform <u>graceful shutdown</u>, then reboot your BlueField device or power cycle the server.</p> <p>Keywords: Hang; reboot</p>
	Reported in version: 3.5.0.11563
23 50 13 2	<p>Description: Boot process hangs at BIOS (version 1.2.11) stage when power cycling a server (model Dell PowerEdge R7525) after configuring "PCI_SWITCH_EMULATION_NUM_PORT" &gt; 27.</p> <p>Workaround: N/A</p> <p>Keywords: Server; hang; power cycle</p>
	Reported in version: 3.5.0.11563

Ref #	Issue
25	<p>Description: On a BlueField device operating in Embedded CPU mode, PXE driver will fail to boot if the Arm side is not fully loaded and the OVS bridge is not configured.</p>
81	<p>Workaround: Run warm reboot on the host side and boot again via the device when Arm is up and the OVS bridge is configured.</p>
8	<p>Keywords: Embedded CPU; PXE; UEFI; Arm</p>
	<p>Reported in version: 2.5.0.11176</p>
	<p>Description: On some setups, DPU does not power on following server cold boot when UART cable is attached to the same server.</p>
18	<p>Workaround: As long as the RShim driver is loaded on the server and the RShim interface is visible, the RShim driver will detect this and auto-reset the card into normal state.</p>
2	<p>Keywords: DPU; Arm; Cold Boot</p>
	<p>Reported in version: 2.4.0.11082</p>
	<p>Description: Driver restart fails when SNAP service is running.</p>
18	<p>Workaround: Stop the SNAP services nvme_sf and nvme_snap@nvme0, then restart the driver. After the driver loads restart the services.</p>
92	<p>Keywords: SNAP</p>
1	<p>Reported in version: 2.2.0.11000</p>
19	<p>Description: Defining namespaces with certain Micron disks (Micron_9300_MTFDHAL3T8TDP) using consecutive attach-ns commands can cause errors.</p>
11	<p>Workaround: Add delay between attach-ns commands.</p>
61	<p>Keywords: Micron; disk; namespace; attach-ns</p>
8	<p>Reported in version: 2.2.0.11000</p>

# Validated and Supported Cables and Modules

## Cables Lifecycle Legend

Lifecycle Phase	Definition
EOL	End of Life
LTB	Last Time Buy
HVM	GA level
MP	GA level
P-Rel	GA level
Preliminary	Engineering Sample
Prototype	Engineering Sample

## Supported Cables and Modules for BlueField-3

## Cables Lifecycle Legend

Lifecycle Phase	Definition
EOL	End of Life
LTB	Last Time Buy
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MP	GA level
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Preliminary	Engineering Sample
Prototype	Engineering Sample

## NDR / 400GbE Cables

<b>IB Data Rate</b>	<b>Eth Data Rate</b>	<b>NVIDIA P/N</b>	<b>Legacy P/N</b>	<b>Description</b>	<b>LifeCycle Phase</b>
N/A	400GE	980-9I08L-00W003	C-DQ8FNM003-NML	NVIDIA Select 400GbE QSFP-DD AOC 3m	Preliminary
N/A	400GE	980-9I08N-00W005	C-DQ8FNM005-NML	NVIDIA Select 400GbE QSFP-DD AOC 5m	Preliminary
N/A	400GE	980-9I08P-00W010	C-DQ8FNM010-NML	NVIDIA Select 400GbE QSFP-DD AOC 10m	Preliminary
N/A	400GE	980-9I08R-00W020	C-DQ8FNM020-NML	NVIDIA Select 400GbE QSFP-DD AOC 20m	Preliminary
N/A	400GE	980-9I08T-00W050	C-DQ8FNM050-NML	NVIDIA Select 400GbE QSFP-DD AOC 50m	Preliminary
NDR	N/A	980-9I81B-00N004	MCA7J65-N004	NVIDIA Active copper splitter cable, IB twin port NDR 800Gb/s to 2x400Gb/s, OSFP to 2xQSFP112, 4m	Prototype
NDR	N/A	980-9I81C-00N005	MCA7J65-N005	NVIDIA Active copper splitter cable, IB twin port NDR 800Gb/s to 2x400Gb/s, OSFP to 2xQSFP112, 5m	Prototype
NDR	N/A	980-9I76G-00N004	MCA7J75-N004	NVIDIA Active copper splitter cable, IB twin port NDR 800Gb/s to 4x200Gb/s, OSFP to 4xQSFP112, 4m	Prototype
NDR	N/A	980-9I76H-00N005	MCA7J75-N005	NVIDIA Active copper splitter cable, IB twin port NDR 800Gb/s to 4x200Gb/s, OSFP to 4xQSFP112, 5m	Prototype
NDR	N/A	980-9I928-00N001	MCP7Y10-N001	NVIDIA passive copper splitter cable, IB twin port NDR 800Gb/s to 2x400Gb/s, OSFP to 2xQSFP112, 1m	P-Rel

<b>IB Data Rate</b>	<b>Eth Data Rate</b>	<b>NVIDIA P/N</b>	<b>Legacy P/N</b>	<b>Description</b>	<b>LifeCycle Phase</b>
NDR	N/A	980-9I929-00N002	MCP7Y10-N002	NVIDIA passive copper splitter cable, IB twin port NDR 800Gb/s to 2x400Gb/s, OSFP to 2xQSFP112,2m	P-Rel
NDR	N/A	980-9I80P-00N003	MCP7Y10-N003	NVIDIA passive copper splitter cable, IB twin port NDR 800Gb/s to 2x400Gb/s, OSFP to 2xQSFP112,3m	P-Rel
NDR	N/A	980-9I80A-00N01A	MCP7Y10-N01A	NVIDIA passive copper splitter cable, IB twin port NDR 800Gb/s to 2x400Gb/s, OSFP to 2xQSFP112,1.5m	P-Rel
NDR	N/A	980-9I80Q-00N02A	MCP7Y10-N02A	NVIDIA passive copper splitter cable, IB twin port NDR 800Gb/s to 2x400Gb/s, OSFP to 2xQSFP112,2.5m	P-Rel
NDR	N/A	980-9I80B-00N001	MCP7Y40-N001	NVIDIA passive copper splitter cable, IB twin port NDR 800Gb/s to 4x200Gb/s, OSFP to 4xQSFP112, 1m	P-Rel
NDR	N/A	980-9I80C-00N002	MCP7Y40-N002	NVIDIA passive copper splitter cable, IB twin port NDR 800Gb/s to 4x200Gb/s, OSFP to 4xQSFP112, 2m	P-Rel
NDR	N/A	980-9I75R-00N003	MCP7Y40-N003	NVIDIA passive copper splitter cable, IB twin port NDR 800Gb/s to 4x200Gb/s, OSFP to 4xQSFP112, 3m	P-Rel
NDR	N/A	980-9I75D-00N01A	MCP7Y40-N01A	NVIDIA passive copper splitter cable, IB twin port NDR 800Gb/s to 4x200Gb/s, OSFP to 4xQSFP112, 1.5m	P-Rel
NDR	N/A	980-9I75S-00N02A	MCP7Y40-N02A	NVIDIA passive copper splitter cable, IB twin port NDR 800Gb/s to 4x200Gb/s, OSFP to 4xQSFP112, 2.5m	P-Rel
NDR	N/A	980-9I73U-000003	MFP7E10-N003	NVIDIA passive fiber cable, MMF , MPO12 APC to MPO12 APC, 3m	MP
NDR	N/A	980-9I73V-	MFP7E10-N005	NVIDIA passive fiber cable, MMF, MPO12 APC to MPO12 APC, 5m	MP

<b>IB Data Rate</b>	<b>Eth Data Rate</b>	<b>NVIDIA P/N</b>	<b>Legacy P/N</b>	<b>Description</b>	<b>LifeCycle Phase</b>
		000005			
NDR	N/A	980-9I57W-000007	MFP7E10-N007	NVIDIA passive fiber cable, MMF, MPO12 APC to MPO12 APC, 7m	MP
NDR	N/A	980-9I57X-00N010	MFP7E10-N010	NVIDIA passive fiber cable, MMF, MPO12 APC to MPO12 APC, 10m	MP
NDR	N/A	980-9I57Y-000015	MFP7E10-N015	NVIDIA passive fiber cable, MMF , MPO12 APC to MPO12 APC, 15m	MP
NDR	N/A	980-9I57Z-000020	MFP7E10-N020	NVIDIA passive fiber cable, MMF, MPO12 APC to MPO12 APC, 20m	MP
NDR	N/A	980-9I573-00N025	MFP7E10-N025	NVIDIA passive fiber cable, MMF, MPO12 APC to MPO12 APC, 25m	MP
NDR	N/A	980-9I570-00N030	MFP7E10-N030	NVIDIA passive fiber cable, MMF, MPO12 APC to MPO12 APC, 30m	MP
NDR	N/A	980-9I570-00N035	MFP7E10-N035	NVIDIA passive fiber cable, MMF, MPO12 APC to MPO12 APC, 35m	MP
NDR	N/A	980-9I570-00N040	MFP7E10-N040	NVIDIA passive fiber cable, MMF, MPO12 APC to MPO12 APC, 40m	MP
NDR	N/A	980-9I57Y-00N050	MFP7E10-N050	NVIDIA passive fiber cable, MMF, MPO12 APC to MPO12 APC, 50m	MP
NDR	N/A	980-9I571-00N003	MFP7E20-N003	NVIDIA passive fiber cable, MMF, MPO12 APC to 2xMPO12 APC, 3m	MP

<b>IB Data Rate</b>	<b>Eth Data Rate</b>	<b>NVIDIA P/N</b>	<b>Legacy P/N</b>	<b>Description</b>	<b>LifeCycle Phase</b>
NDR	N/A	980-9I572-00N005	MFP7E20-N005	NVIDIA passive fiber cable, MMF, MPO12 APC to 2xMPO12 APC, 5m	MP
NDR	N/A	980-9I573-00N007	MFP7E20-N007	NVIDIA passive fiber cable, MMF, MPO12 APC to 2xMPO12 APC, 7m	MP
NDR	N/A	980-9I554-00N010	MFP7E20-N010	NVIDIA passive fiber cable, MMF, MPO12 APC to 2xMPO12 APC, 10m	MP
NDR	N/A	980-9I555-00N015	MFP7E20-N015	NVIDIA passive fiber cable, MMF, MPO12 APC to 2xMPO12 APC, 15m	MP
NDR	N/A	980-9I556-00N020	MFP7E20-N020	NVIDIA passive fiber cable, MMF, MPO12 APC to 2xMPO12 APC, 20m	MP
NDR	N/A	980-9I557-00N030	MFP7E20-N030	NVIDIA passive fiber cable, MMF, MPO12 APC to 2xMPO12 APC, 30m	MP
NDR	N/A	980-9I55Z-00N050	MFP7E20-N050	NVIDIA passive fiber cable, MMF, MPO12 APC to 2xMPO12 APC, 50m	MP
NDR	N/A	980-9I558-00N001	MFP7E30-N001	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 1m	MP
NDR	N/A	980-9I559-00N002	MFP7E30-N002	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 2m	MP
NDR	N/A	980-9I55A-00N003	MFP7E30-N003	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 3m	MP
NDR	N/A	980-9I55B-	MFP7E30-N005	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 5m	MP

<b>IB Data Rate</b>	<b>Eth Data Rate</b>	<b>NVIDIA P/N</b>	<b>Legacy P/N</b>	<b>Description</b>	<b>LifeCycle Phase</b>
		00N005			
NDR	N/A	980-9I58C-00N007	MFP7E30-N007	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 7m	MP
NDR	N/A	980-9I58D-00N010	MFP7E30-N010	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 10m	MP
NDR	N/A	980-9I58E-00N015	MFP7E30-N015	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 15m	MP
NDR	N/A	980-9I58F-00N020	MFP7E30-N020	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 20m	MP
NDR	N/A	980-9I58G-00N030	MFP7E30-N030	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 30m	MP
NDR	N/A	980-9I580-00N030	MFP7E30-N040	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 40m	MP
NDR	N/A	980-9I58H-00N050	MFP7E30-N050	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 50m	MP
NDR	N/A	980-9I581-00N050	MFP7E30-N060	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 60m	MP
NDR	N/A	980-9I582-00N050	MFP7E30-N070	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 70m	MP
NDR	N/A	980-9I58I-00N100	MFP7E30-N100	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 100m	MP

<b>IB Data Rate</b>	<b>Eth Data Rate</b>	<b>NVIDIA P/N</b>	<b>Legacy P/N</b>	<b>Description</b>	<b>LifeCycle Phase</b>
NDR	N/A	980-9I58J-00N150	MFP7E30-N150	NVIDIA passive fiber cable, SMF, MPO12 APC to MPO12 APC, 150m	MP
NDR	N/A	980-9I58K-00N003	MFP7E40-N003	NVIDIA passive fiber cable, SMF, MPO12 APC to 2xMPO12 APC, 3m	MP
NDR	N/A	980-9I58L-00N005	MFP7E40-N005	NVIDIA passive fiber cable, SMF, MPO12 APC to 2xMPO12 APC, 5m	MP
NDR	N/A	980-9I58M-00N007	MFP7E40-N007	NVIDIA passive fiber cable, SMF, MPO12 APC to 2xMPO12 APC, 7m	MP
NDR	N/A	980-9I58N-00N010	MFP7E40-N010	NVIDIA passive fiber cable, SMF, MPO12 APC to 2xMPO12 APC, 10m	MP
NDR	N/A	980-9I56O-00N015	MFP7E40-N015	NVIDIA passive fiber cable, SMF, MPO12 APC to 2xMPO12 APC, 15m	MP
NDR	N/A	980-9I56P-00N020	MFP7E40-N020	NVIDIA passive fiber cable, SMF, MPO12 APC to 2xMPO12 APC, 20m	MP
NDR	N/A	980-9I56Q-00N030	MFP7E40-N030	NVIDIA passive fiber cable, SMF, MPO12 APC to 2xMPO12 APC, 30m	MP
NDR	N/A	980-9I56R-000050	MFP7E40-N050	NVIDIA passive fiber cable, SMF, MPO12 APC to 2xMPO12 APC, 50m	MP
NDR	N/A	980-9I693-00NS00	MMA1Z00-NS400	NVIDIA single port transceiver, 400Gbps,NDR, QSFP112, MPO12 APC, 850nm MMF, up to 50m, flat top	P-Rel

## HDR / 200GbE Cables

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
HDR	200G E	980-9I548-00H001	MCP1650-H001E30	Nvidia Passive Copper cable, up to 200Gbps, QSFP56 to QSFP56, 1m	HVM
HDR	200G E	980-9I549-00H002	MCP1650-H002E26	Nvidia Passive Copper cable, up to 200Gbps, QSFP56 to QSFP56, 2m	HVM
HDR	200G E	980-9I54A-00H00A	MCP1650-H00AE30	Nvidia Passive Copper cable, up to 200Gbps, QSFP56 to QSFP56, 0.5m	HVM
HDR	200G E	980-9I54B-00H01A	MCP1650-H01AE30	Nvidia Passive Copper cable, up to 200Gbps, QSFP56 to QSFP56, 1.5 m	HVM
N/A	200G E	980-9I54C-00V001	MCP1650-V001E30	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 1m, black pulltab, 30AWG	LTB [HVM]
N/A	200G E	980-9I54D-00V002	MCP1650-V002E26	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 2m, black pulltab, 26AWG	LTB [HVM]
N/A	200G E	980-9I54G-00V003	MCP1650-V003E26	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 3m, black pulltab, 26AWG	EOL [HVM]
N/A	200G E	980-9I54H-00V00A	MCP1650-	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 0.5m, black pulltab, 30AWG	LTB [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
			V00AE30		
N/A	200GE	980-9I54I-00V01A	MCP1650-V01AE30	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 1.5m, black pulltab, 30AWG	LTB [HVM]
N/A	200GE	980-9I54L-00V02A	MCP1650-V02AE26	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 2.5m, black pulltab, 26AWG	LTB [HVM]
HDR	200GE	980-9I39E-00H001	MCP7H50-H001R30	Nvidia Passive copper splitter cable, 200Gbps to 2x100Gbps, QSFP56 to 2xQSFP56, 1m	HVM
HDR	200GE	980-9I99F-00H002	MCP7H50-H002R26	Nvidia Passive copper splitter cable, 200Gbps to 2x100Gbps, QSFP56 to 2xQSFP56, 2m	HVM
HDR	200GE	980-9I98G-00H01A	MCP7H50-H01AR30	Nvidia Passive copper splitter cable, 200Gbps to 2x100Gbps, QSFP56 to 2xQSFP56, 1.5m	HVM
N/A	200GE	980-9I98H-00V001	MCP7H50-V001R30	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 1m, 30AWG	LTB [HVM]
N/A	200GE	980-9I98I-00V002	MCP7H50-V002R26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 2m, 26AWG	LTB [HVM]
N/A	200GE	980-9I98J-00V003	MCP7H50-	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 3m, 26AWG	EOL [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
			V003R26		
N/A	200GE	980-9I98K-00V01A	MCP7H50-V01AR30	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 1.5m, 30AWG	EOL [HVM]
N/A	200GE	980-9I98M-00V02A	MCP7H50-V02AR26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 2.5m, 26AWG	LTB [HVM]
N/A	200GE	980-9IA3X-00V001	MCP7H70-V001R30	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 4x50Gb/s, QSFP56 to 4xSFP56, colored, 1m, 30AWG	EOL [P-Rel]
N/A	200GE	980-9IA3Y-00V002	MCP7H70-V002R26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 4x50Gb/s, QSFP56 to 4xSFP56, colored, 2m, 26AWG	EOL [P-Rel]
N/A	200GE	980-9I43Z-00V003	MCP7H70-V003R26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 4x50Gb/s, QSFP56 to 4x4SFP56, colored, 3m, 26AWG	EOL [P-Rel]
N/A	200GE	980-9I430-00V01A	MCP7H70-V01AR30	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 4x50Gb/s, QSFP56 to 4xSFP56, colored, 1.5m, 30AWG	EOL [P-Rel]
N/A	200GE	980-9I431-00V02A	MCP7H70-V02AR26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 4x50Gb/s, QSFP56 to 4xSFP56, colored, 2.5m, 26AWG	EOL [P-Rel]
HDR	200GE	980-9I46K-00H001	MCP7Y60-H001	NVIDIA passive copper splitter cable, 400(2x200)Gbps to 2x200Gbps, OSFP to 2xQSFP56, 1m, fin to flat	MP

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
HDR	200G E	980-9I46L-00H002	MCP7Y60-H002	NVIDIA passive copper splitter cable, 400(2x200)Gbps to 2x200Gbps, OSFP to 2xQSFP56, 2m, fin to flat	MP
HDR	200G E	980-9I93M-00H01A	MCP7Y60-H01A	NVIDIA passive copper splitter cable, 400(2x200)Gbps to 2x200Gbps, OSFP to 2xQSFP56, 1.5m, fin to flat	MP
HDR	200G E	980-9I93N-00H001	MCP7Y70-H001	NVIDIA passive copper splitter cable, 400(2x200)Gbps to 4x100Gbps, OSFP to 4xQSFP56, 1m, fin to flat	MP
HDR	200G E	980-9I93O-00H002	MCP7Y70-H002	NVIDIA passive copper splitter cable, 400(2x200)Gbps to 4x100Gbps, OSFP to 4xQSFP56, 2m, fin to flat	MP
HDR	200G E	980-9I47P-00H01A	MCP7Y70-H01A	NVIDIA passive copper splitter cable, 400(2x200)Gbps to 4x100Gbps, OSFP to 4xQSFP56, 1.5m, fin to flat	MP
HDR	N/A	980-9I124-00H003	MFS1S00-H003E	NVIDIA active fiber cable, IB HDR, up to 200Gb/s, QSFP56, LSZH, black pulltab, 3m	EOL [HVM]
HDR	200G E	980-9I457-00H003	MFS1S00-H003V	Nvidia active optical cable, up to 200Gbps , QSFP56 to QSFP56, 3m	MP
HDR	N/A	980-9I45A-00H005	MFS1S00-H005E	NVIDIA active fiber cable, IB HDR, up to 200Gb/s, QSFP56, LSZH, black pulltab, 5m	EOL [HVM]
HDR	200G E	980-9I45D-00H005	MFS1S00-H005V	Nvidia active optical cable, up to 200Gbps , QSFP56 to QSFP56, 5m	MP
HDR	N/A	980-9I45G-00H010	MFS1S00-H010E	NVIDIA active fiber cable, IB HDR, up to 200Gb/s, QSFP56, LSZH, black pulltab, 10m	EOL [HVM]
HDR	200G E	980-9I45J-	MFS1S00-	Nvidia active optical cable, up to 200Gbps , QSFP56 to QSFP56, 10m	MP

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
		00H010	H010V		
HDR	N/A	980-9I45M-00H015	MFS1S00-H015E	NVIDIA active fiber cable, IB HDR, up to 200Gb/s, QSFP56, LSZH, black pulltab, 15m	EOL [HVM]
HDR	200G E	980-9I45O-00H015	MFS1S00-H015V	Nvidia active optical cable, up to 200Gbps , QSFP56 to QSFP56, 15m	MP
HDR	N/A	980-9I45R-00H020	MFS1S00-H020E	NVIDIA active fiber cable, IB HDR, up to 200Gb/s, QSFP56, LSZH, black pulltab, 20m	EOL [HVM]
HDR	200G E	980-9I45T-00H020	MFS1S00-H020V	Nvidia active optical cable, up to 200Gbps , QSFP56 to QSFP56, 20m	MP
HDR	N/A	980-9I45Y-00H030	MFS1S00-H030E	NVIDIA active fiber cable, IB HDR, up to 200Gb/s, QSFP56, LSZH, black pulltab, 30m	EOL [HVM]
HDR	200G E	980-9I440-00H030	MFS1S00-H030V	Nvidia active optical cable, up to 200Gbps , QSFP56 to QSFP56, 30m	MP
HDR	N/A	980-9I455-00H050	MFS1S00-H050E	NVIDIA active fiber cable, IB HDR, up to 200Gb/s, QSFP56, LSZH, black pulltab, 50m	EOL [HVM]
HDR	200G E	980-9I447-00H050	MFS1S00-H050V	Nvidia active optical cable, up to 200Gbps , QSFP56 to QSFP56, 50m	MP
HDR	N/A	980-9I44G-00H100	MFS1S00-H100E	NVIDIA active fiber cable, IB HDR, up to 200Gb/s, QSFP56, LSZH, black pulltab, 100m	EOL [HVM]
HDR	200G E	980-9I44H-00H100	MFS1S00-H100V	Nvidia active optical cable, up to 200Gbps , QSFP56 to QSFP56, 100m	MP

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
HDR	N/A	980-9I44I-00H130	MFS1S00-H130E	NVIDIA active fiber cable, IB HDR, up to 200Gb/s, QSFP56, LSZH, black pulltab, 130m	EOL [HVM]
HDR	200G E	980-9I44K-00H130	MFS1S00-H130V	Nvidia active optical cable, up to 200Gbps , QSFP56 to QSFP56, 130m	MP
HDR	200G E	980-9I44N-00H150	MFS1S00-H150V	Nvidia active optical cable, up to 200Gbps , QSFP56 to QSFP56, 150m	MP
N/A	200G E	980-9I44P-00V003	MFS1S00-V003E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 3m	LTB [HVM]
N/A	200G E	980-9I45Q-00V005	MFS1S00-V005E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 5m	LTB [HVM]
N/A	200G E	980-9I45R-00V010	MFS1S00-V010E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 10m	LTB [HVM]
N/A	200G E	980-9I44S-00V015	MFS1S00-V015E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 15m	LTB [HVM]
N/A	200G E	980-9I44T-00V020	MFS1S00-V020E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 20m	LTB [HVM]
N/A	200G E	980-9I44U-00V030	MFS1S00-V030E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 30m	LTB [HVM]
N/A	200G E	980-9I44V-00V050	MFS1S00-V050E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 50m	LTB [HVM]
N/A	200G E	980-9I44W-	MFS1S00-V100E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab,	EOL [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
		00V100		100m	[HIBERN/ATE]
HDR	N/A	980-9I452-00H003	MFS1S50-H003E	NVIDIA active fiber splitter cable, IB HDR, 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56 , LSZH, 3m	EOL [HVM]
HDR	200G E	980-9I445-00H003	MFS1S50-H003V	Nvidia active optical splitter cable, 200Gbps to 2x100Gbps , QSFP56 to 2xQSFP56, 3m	HVM
HDR	N/A	980-9I956-00H005	MFS1S50-H005E	NVIDIA active fiber splitter cable, IB HDR, 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56 , LSZH, 5m	EOL [HVM]
HDR	200G E	980-9I969-00H005	MFS1S50-H005V	Nvidia active optical splitter cable, 200Gbps to 2x100Gbps , QSFP56 to 2xQSFP56, 5m	HVM
HDR	N/A	980-9I95A-00H010	MFS1S50-H010E	NVIDIA active fiber splitter cable, IB HDR, 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56 , LSZH, 10m	EOL [HVM]
HDR	200G E	980-9I96D-00H010	MFS1S50-H010V	Nvidia active optical splitter cable, 200Gbps to 2x100Gbps , QSFP56 to 2xQSFP56, 10m	HVM
HDR	N/A	980-9I95E-00H015	MFS1S50-H015E	NVIDIA active fiber splitter cable, IB HDR, 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56 , LSZH, 15m	EOL [HVM]
HDR	200G E	980-9I96H-00H015	MFS1S50-H015V	Nvidia active optical splitter cable, 200Gbps to 2x100Gbps , QSFP56 to 2xQSFP56, 15m	HVM
HDR	N/A	980-9I95I-00H020	MFS1S50-H020E	NVIDIA active fiber splitter cable, IB HDR, 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56 , LSZH, 20m	EOL [HVM]
HDR	200G E	980-9I96L-00H020	MFS1S50-H020V	Nvidia active optical splitter cable, 200Gbps to 2x100Gbps , QSFP56 to 2xQSFP56, 20m	HVM

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
HDR	N/A	980-9I95M-00H030	MFS1S50-H030E	NVIDIA active fiber splitter cable, IB HDR, 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56 , LSZH, 30m	EOL [HVM]
HDR	200G E	980-9I96P-00H030	MFS1S50-H030V	Nvidia active optical splitter cable, 200Gbps to 2x100Gbps , QSFP56 to 2xQSFP56, 30m	HVM
HDR	200G E	980-9I95S-00H040	MFS1S50-H040V	Nvidia active optical splitter cable, 200Gbps to 2x100Gbps , QSFP56 to 2xQSFP56, 40m	Prototype
HDR	200G E	980-9I95T-00H050	MFS1S50-H050V	Nvidia active optical splitter cable, 200Gbps to 2x100Gbps , QSFP56 to 2xQSFP56, 50m	Prototype
N/A	200G E	980-9I95Q-00V003	MFS1S50-V003E	NVIDIA active fiber splitter cable, 200GbE, 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, LSZH, black pulltab, 3m	EOL [HVM]
N/A	200G E	980-9I96R-00V005	MFS1S50-V005E	NVIDIA active fiber splitter cable, 200GbE, 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, LSZH, black pulltab, 5m	EOL [HVM]
N/A	200G E	980-9I96S-00V010	MFS1S50-V010E	NVIDIA active fiber splitter cable, 200GbE, 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, LSZH, black pulltab, 10m	EOL [HVM]
N/A	200G E	980-9I96T-00V015	MFS1S50-V015E	NVIDIA active fiber splitter cable, 200GbE, 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, LSZH, black pulltab, 15m	EOL [HVM]
N/A	200G E	980-9I95U-00V020	MFS1S50-V020E	NVIDIA active fiber splitter cable, 200GbE, 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, LSZH, black pulltab, 20m	EOL [HVM]
N/A	200G E	980-9I95V-00V030	MFS1S50-V030E	NVIDIA active fiber splitter cable, 200GbE, 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, LSZH, black pulltab, 30m	EOL [HVM]
HDR	N/A	980-9I961-	MFS1S90-H010E	NVIDIA active fiber splitter cable, IB HDR, 2x200Gb/s to 2x200Gb/s, 2xQSFP56 to	LTB [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
		00H010		2xQSFP56 , LSZH, 10m	
HDR	N/A	980-9I423-00H020	MFS1S90-H020E	NVIDIA active fiber splitter cable, IB HDR, 2x200Gb/s to 2x200Gb/s, 2xQSFP56 to 2xQSFP56 , LSZH, 20m	LTB [HVM]
HDR	N/A	980-9I424-00H030	MFS1S90-H030E	NVIDIA active fiber splitter cable, IB HDR, 2x200Gb/s to 2x200Gb/s, 2xQSFP56 to 2xQSFP56 , LSZH, 30m	EOL [HVM]
HDR	N/A	980-9I17S-00HS00	MMA1T00-HS	NVIDIA transceiver, HDR, QSFP56, MPO, 850nm, SR4, up to 100m	HVM
N/A	200GbE	980-9I20T-00V000	MMA1T00-VS	NVIDIA transceiver, 200GbE, up to 200Gb/s, QSFP56, MPO, 850nm, SR4, up to 100m	HVM

## EDR / 100GbE Cables

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	100GbE	980-9I620-00C001	MCP1600-C001	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 1m 30AWG	EOL [HVM]
N/A	100GbE	980-9I620-00C001	MCP1600-C001E30N	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP28, 1m, Black, 30AWG, CA-N	HVM
N/A	100GbE	980-9I62S-00C001	MCP1600-C001LZ	NVIDIA Passive Copper Cable, ETH 100GbE, 100Gb/s, QSFP, 1m, LSZH, 30AWG	EOL [MP]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	100G E	980-9I621-00C002	MCP160 0-C002	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 2m 30AWG	EOL [HVM]
N/A	100G E	980-9I622-00C002	MCP160 0-C002E26 N	NVIDIA® Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP28, 2m, Black, 26AWG, CA-N	Preliminary
N/A	100G E	980-9I62V-00C002	MCP160 0-C002E30 N	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP28, 2m, Black, 30AWG, CA-N	HVM
N/A	100G E	980-9I62X-00C003	MCP160 0-C003	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 3m 28AWG	EOL [HVM]
N/A	100G E	980-9I62Z-00C003	MCP160 0-C003E26 N	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP28, 3m, Black, 26AWG, CA-N	EOL [HVM]
N/A	100G E	980-9I620-00C003	MCP160 0-C003E30 L	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP28, 3m, Black, 30AWG, CA-L	HVM
N/A	100G E	980-9I622-00C003	MCP160 0-C003LZ	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP, 3m, LSZH, 26AWG	EOL [MP]
N/A	100G E	980-9I625-00C005	MCP160 0-C005E26 L	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP28, 5m, Black, 26AWG, CA-L	HVM
N/A	100G E	980-9I626-00C00A	MCP160 0-C00A	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 0.5m 30AWG	EOL [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	100G E	980-9I627-00C00A	MCP160 0-C00AE3 0N	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP28, 0.5m, Black, 30AWG, CA-N	EOL [HVM]
N/A	100G E	980-9I629-00C00B	MCP160 0-C00BE3 0N	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP28, 0.75m, Black, 30AWG, CA-N	EOL [HVM]
N/A	100G E	980-9I62B-00C01A	MCP160 0-C01A	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 1.5m 30AWG	EOL [HVM]
N/A	100G E	980-9I62C-00C01A	MCP160 0-C01AE3 0N	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP28, 1.5m, Black, 30AWG, CA-N	HVM
N/A	100G E	980-9I62G-00C02A	MCP160 0-C02A	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 2.5m 30AWG	EOL [HVM]
N/A	100G E	980-9I62H-00C02A	MCP160 0-C02AE2 6N	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP28, 2.5m, Black, 26AWG, CA-N	EOL [HVM]
N/A	100G E	980-9I62I-00C02A	MCP160 0-C02AE3 0L	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP28, 2.5m, Black, 30AWG, CA-L	HVM
N/A	100G E	980-9I62M-00C03A	MCP160 0-C03A	NVIDIA Passive Copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 3.5m 26AWG	EOL [P-Rel]
EDR	100G E	980-9I62P-00C001	MCP160 0-E001	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 1m 30AWG	EOL [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
EDR	N/A	980-9I62Q-00E001	MCP1600-E001E30	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP28, 1m, Black, 30AWG	HVM
EDR	100G E	980-9I62S-00C002	MCP1600-E002	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 2m 28AWG	EOL [HVM]
EDR	N/A	980-9I62T-00E002	MCP1600-E002E26	NVIDIA® Passive Copper cable, IB EDR, up to 100Gb/s, QSFP28, 2m, Black, 26AWG	Preliminary
EDR	N/A	980-9I62U-00E002	MCP1600-E002E30	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP28, 2m, Black, 30AWG	HVM
EDR	100G E	980-9I62V-00C003	MCP1600-E003	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 3m 26AWG	EOL [HVM]
EDR	N/A	980-9I62W-00E003	MCP1600-E003E26	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP28, 3m, Black, 26AWG	HVM
EDR	N/A	980-9I62Y-00E004	MCP1600-E004E26	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP28, 4m, Black, 26AWG	EOL [HVM]
EDR	N/A	980-9I62Z-00E005	MCP1600-E005E26	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP28, 5m, Black, 26AWG	HVM
EDR	N/A	980-9I620-00E00A	MCP1600-E00A	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 0.5m 30AWG	EOL [HVM]
EDR	N/A	980-9I621-00E00A	MCP1600-E00AE30	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP28, 0.5m, Black, 30AWG	EOL [HVM]
EDR	N/A	980-9I622-	MCP1600-	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP28, 0.75m, Black, 30AWG	EOL [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
		00E00B	E00BE30		[HIBERN/ATE]
EDR	100G E	980-9I623-00C01A	MCP160 0-E01A	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 1.5m 30AWG	EOL [HVM]
EDR	N/A	980-9I624-00E01A	MCP160 0-E01AE30	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP28, 1.5m, Black, 30AWG	HVM
EDR	N/A	980-9I625-00E01C	MCP160 0-E01BE30	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP28, 1.25m, Black, 30AWG	EOL [HVM] [HIBERN/ATE]
EDR	100G E	980-9I626-00C02A	MCP160 0-E02A	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 2.5m 26AWG	EOL [HVM]
EDR	N/A	980-9I627-00E02A	MCP160 0-E02AE26	NVIDIA Passive Copper cable, IB EDR, up to 100Gb/s, QSFP28, 2.5m, Black, 26AWG	HVM
N/A	100G E	980-9I645-00C001	MCP7F0 0-A001R	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, colored pulltabs, 1m, 30AWG	EOL [HVM]
N/A	100G E	980-9I486-00C001	MCP7F0 0-A001R3 ON	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 1m, Colored, 30AWG, CA-N	LTB [HVM]
N/A	100G E	980-9I48A-00C002	MCP7F0 0-A002R	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, colored pulltabs, 2m, 30AWG	EOL [HVM]
N/A	100G E	980-9I48B-00C002	MCP7F0 0-A002R3 ON	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 2m, Colored, 30AWG, CA-N	LTB [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	100G E	980-9I48G-00C003	MCP7F00-A003R26N	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 3m, Colored, 26AWG, CA-N	EOL [HVM]
N/A	100G E	980-9I48H-00C003	MCP7F00-A003R30L	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 3m, Colored, 30AWG, CA-L	LTB [HVM]
N/A	100G E	980-9I48J-00C005	MCP7F00-A005R26L	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 5m, Colored, 26AWG, CA-L	LTB [HVM]
N/A	100G E	980-9I48M-00C01A	MCP7F00-A01AR	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, colored pulltabs, 1.5m, 30AWG	EOL [HVM]
N/A	100G E	980-9I48N-00C01A	MCP7F00-A01AR30N	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 1.5m, Colored, 30AWG, CA-N	LTB [HVM]
N/A	100G E	980-9I48S-00C02A	MCP7F00-A02AR26N	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 2.5m, Colored, 26AWG, CA-N	EOL [HVM]
N/A	100G E	980-9I48T-00C02A	MCP7F00-A02AR30L	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 2.5m, Colored, 30AWG, CA-L	LTB [HVM]
N/A	100G E	980-9I48U-00C02A	MCP7F00-A02ARLZ	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 2.5m, LSZH, Colored, 28AWG	EOL [P-Rel]
N/A	100G E	980-9I48X-	MCP7F00-	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28,	EOL [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
		00C03A	A03AR2 6L	3.5m, Colored, 26AWG, CA-L	
N/A	100G E	980-9I61C-00C005	MCP7H00-G00000	NVIDIA® passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 5m, Colored, 26AWG, CA-L	Preliminary
N/A	100G E	980-9I61D-00C001	MCP7H00-G001	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 1m, 30AWG	EOL [HVM]
N/A	100G E	980-9I99F-00C001	MCP7H00-G001R	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, colored pulltabs, 1m, 30AWG	EOL [HVM]
N/A	100G E	980-9I99G-00C001	MCP7H00-G001R3 ON	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 1m, Colored, 30AWG, CA-N	LTB [HVM]
N/A	100G E	980-9I99J-00C002	MCP7H00-G002R	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, colored pulltabs, 2m, 30AWG	EOL [HVM]
N/A	100G E	980-9I99K-00C002	MCP7H00-G002R2 6N	NVIDIA® passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 2m, Colored, 26AWG, CA-N	Preliminary
N/A	100G E	980-9I99L-00C002	MCP7H00-G002R3 ON	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 2m, Colored, 30AWG, CA-N	LTB [HVM]
N/A	100G E	980-9I99O-00C003	MCP7H00-G003R	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, colored pulltabs, 3m, 28AWG	EOL [HVM]
N/A	100G E	980-9I99Q-00C003	MCP7H00-	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 3m, Colored, 26AWG, CA-N	EOL [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
			G003R2 6N		
N/A	100G E	980-9I39R-00C003	MCP7H0 0- G003R3 0L	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 3m, Colored, 30AWG, CA-L	LTB [HVM]
N/A	100G E	980-9I99S-00C004	MCP7H0 0- G004R2 6L	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 4m, Colored, 26AWG, CA-L	EOL [HVM]
N/A	100G E	980-9I99W-00C01A	MCP7H0 0-G01AR	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, colored pulltabs, 1.5m, 30AWG	EOL [HVM]
N/A	100G E	980-9I99X-00C01A	MCP7H0 0- G01AR3 0N	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 1.5m, Colored, 30AWG, CA-N	LTB [HVM]
N/A	100G E	980-9I992-00C02A	MCP7H0 0-G02AR	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, colored pulltabs, 2.5m, 30AWG	EOL [HVM]
N/A	100G E	980-9I994-00C02A	MCP7H0 0- G02AR2 6N	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 2.5m, Colored, 26AWG, CA-N	EOL [HVM]
N/A	100G E	980-9I395-00C02A	MCP7H0 0- G02AR3 0L	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 2.5m, Colored, 30AWG, CA-L	LTB [HVM]
N/A	100G E	980-9I13S-00C003	MFA1A0 0-C003	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 3m	HVM

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	100G E	980-9I13X-00C005	MFA1A0 0-C005	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 5m	HVM
N/A	100G E	980-9I134-00C010	MFA1A0 0-C010	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 10m	HVM
N/A	100G E	980-9I13A-00C015	MFA1A0 0-C015	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 15m	HVM
N/A	100G E	980-9I13F-00C020	MFA1A0 0-C020	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 20m	HVM
N/A	100G E	980-9I13N-00C030	MFA1A0 0-C030	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 30m	HVM
N/A	100G E	980-9I130-00C050	MFA1A0 0-C050	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 50m	HVM
N/A	100G E	980-9I13B-00C100	MFA1A0 0-C100	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 100m	LTB [HVM]
EDR	N/A	980-9I13D-00E001	MFA1A0 0-E001	NVIDIA active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 1m	HVM
EDR	N/A	980-9I13F-00E003	MFA1A0 0-E003	NVIDIA active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 3m	HVM
EDR	N/A	980-9I13J-00E005	MFA1A0 0-E005	NVIDIA active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 5m	HVM
EDR	N/A	980-9I13M-	MFA1A0 0-E007	NVIDIA active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 7m	LTB [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
		00E007			
EDR	N/A	980-9I13O-00E010	MFA1A00-E010	NVIDIA active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 10m	HVM
EDR	N/A	980-9I13S-00E015	MFA1A00-E015	NVIDIA active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 15m	HVM
EDR	N/A	980-9I13V-00E020	MFA1A00-E020	NVIDIA active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 20m	HVM
EDR	N/A	980-9I13Y-00E030	MFA1A00-E030	NVIDIA active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 30m	HVM
EDR	N/A	980-9I133-00E050	MFA1A00-E050	NVIDIA active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 50m	HVM
EDR	N/A	980-9I135-00E100	MFA1A00-E100	NVIDIA active fiber cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 100m	LTB [HVM]
N/A	100G E	980-9I37H-00C003	MFA7A20-C003	NVIDIA active fiber hybrid solution, ETH 100GbE to 2x50GbE, QSFP28 to 2xQSFP28, 3m	EOL [HVM]
N/A	100G E	980-9I37I-00C005	MFA7A20-C005	NVIDIA active fiber hybrid solution, ETH 100GbE to 2x50GbE, QSFP28 to 2xQSFP28, 5m	EOL [HVM]
N/A	100G E	980-9I40J-00C010	MFA7A20-C010	NVIDIA active fiber hybrid solution, ETH 100GbE to 2x50GbE, QSFP28 to 2xQSFP28, 10m	EOL [HVM]
N/A	100G E	980-9I40K-00C020	MFA7A20-C020	NVIDIA active fiber hybrid solution, ETH 100GbE to 2x50GbE, QSFP28 to 2xQSFP28, 20m	EOL [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	100G E	980-9I40L-00C002	MFA7A20-C02A	NVIDIA® active fiber hybrid solution, ETH 100GbE to 2x50GbE, QSFP28 to 2xQSFP28, 2.5m	Preliminary
N/A	100G E	980-9I40M-00C003	MFA7A20-C03A	NVIDIA® active fiber hybrid solution, ETH 100GbE to 2x50GbE, QSFP28 to 2xQSFP28, 3.5m	Preliminary
N/A	100G E	980-9I40N-00C003	MFA7A50-C003	NVIDIA active fiber hybrid solution, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 3m	EOL [HVM]
N/A	100G E	980-9I40O-00C005	MFA7A50-C005	NVIDIA active fiber hybrid solution, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 5m	EOL [HVM]
N/A	100G E	980-9I49P-00C010	MFA7A50-C010	NVIDIA active fiber hybrid solution, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 10m	EOL [HVM]
N/A	100G E	980-9I49Q-00C015	MFA7A50-C015	NVIDIA active fiber hybrid solution, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 15m	EOL [HVM]
N/A	100G E	980-9I49R-00C020	MFA7A50-C020	NVIDIA active fiber hybrid solution, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 20m	EOL [HVM]
N/A	100G E	980-9I49S-00C030	MFA7A50-C030	NVIDIA active fiber hybrid solution, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 30m	EOL [HVM]
N/A	100G E	980-9I149-00CS00	MMA1B00-C100D	NVIDIA transceiver, 100GbE, QSFP28, MPO, 850nm, SR4, up to 100m, DDMI	HVM
N/A	100G E	980-9I17D-00CS00	MMA1B00-C100T	NVIDIA® transceiver, 100GbE, QSFP28, MPO, 850nm, up to 100m, OTU4	Preliminary
EDR	N/A	980-9I17L-	MMA1B00-E100	NVIDIA transceiver, IB EDR, up to 100Gb/s, QSFP28, MPO, 850nm, SR4, up to 100m	HVM

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
		00E000			
N/A	100G E	980-9I17P-00CR00	MMA1L10-CR	NVIDIA optical transceiver, 100GbE, 100Gb/s, QSFP28, LC-LC, 1310nm, LR4 up to 10km	HVM
N/A	100G E	980-9I17Q-00CM00	MMA1L30-CM	NVIDIA optical module, 100GbE, 100Gb/s, QSFP28, LC-LC, 1310nm, CWDM4, up to 2km	MP
N/A	100G E	980-9I16X-00C000	MMS1C10-CM	NVIDIA active optical module, 100Gb/s, QSFP, MPO, 1310nm, PSM4, up to 500m	EOL [MP]
N/A	100G E	980-9I53X-00C000	SPQ-CE-ER-CDFL-M	40km 100G QSFP28 ER Optical Transceiver	P-Rel
N/A	100G E	980-9I63F-00CM00	X65406	NVIDIA® optical module, 100GbE, 100Gb/s, QSFP28, LC-LC, 1310nm, CWDM4, up to 2km	Preliminary

## FDR / 56GbE Cables

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
FDR	56GE	980-9I679-00L004	MC2207126-004	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 4m	EOL [HVM]
FDR	56GE	980-9I67A-00L003	MC2207128-003	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 3m	EOL [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
FDR	56GE	980-9I67C-00L02A	MC2207 128-0A2	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 2.5m	EOL [MP]
FDR	56GE	980-9I67D-00L001	MC2207 130-001	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 1m	EOL [HVM]
FDR	56GE	980-9I67E-00L002	MC2207 130-002	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 2m	EOL [HVM]
FDR	56GE	980-9I67F-00L00A	MC2207 130-00A	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 0.5m	EOL [HVM]
FDR	56GE	980-9I67G-00L01A	MC2207 130-0A1	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 1.5m	EOL [HVM]
FDR	56GE	980-9I15U-00L003	MC2207 31V-003	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 3m	EOL [HVM]
FDR	56GE	980-9I15V-00L005	MC2207 31V-005	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 5m	EOL [HVM]
FDR	56GE	980-9I15W-00L010	MC2207 31V-010	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 10m	EOL [HVM]
FDR	56GE	980-9I15X-00L015	MC2207 31V-015	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 15m	EOL [HVM]
FDR	56GE	980-9I15Y-00L020	MC2207 31V-020	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 20m	EOL [HVM]
FDR	56GE	980-9I15Z-	MC2207 31V-025	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 25m	EOL [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
		00L025			
FDR	56GE	980-9I150-00L030	MC2207 31V-030	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 30m	EOL [HVM]
FDR	56GE	980-9I151-00L040	MC2207 31V-040	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 40m	EOL [HVM] [HIBERN/ATE]
FDR	56GE	980-9I152-00L050	MC2207 31V-050	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 50m	EOL [HVM]
FDR	56GE	980-9I153-00L075	MC2207 31V-075	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 75m	EOL [HVM]
FDR	56GE	980-9I154-00L100	MC2207 31V-100	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 100m	EOL [HVM]
FDR	56GE	980-9I675-00L001	MCP170 L-F001	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, LSZH, 1m	EOL [P-Rel]
FDR	56GE	980-9I676-00L002	MCP170 L-F002	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, LSZH, 2m	EOL [P-Rel]
FDR	56GE	980-9I677-00L003	MCP170 L-F003	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, LSZH, 3m	EOL [P-Rel] [HIBERN/ATE]
FDR	56GE	980-9I678-00L00A	MCP170 L-F00A	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, LSZH, 0.5m	EOL [P-Rel]
FDR	56GE	980-9I679-00L01A	MCP170 L-F01A	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, LSZH, 1.5m	EOL [P-Rel] [HIBERN/ATE]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
FDR	N/A	980-9I17M-00FS00	MMA1B0 0-F030D	NVIDIA transceiver, FDR, QSFP+, MPO, 850nm, SR4, up to 30m, DDMI	LTB [HVM]

## 25GbE Cables

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	10GE	980-9I71G-00J000	MAM1 Q00A-QSA	NVIDIA cable module, ETH 10GbE, 40Gb/s to 10Gb/s, QSFP to SFP+	HVM
N/A	10GE	980-9I65P-00J005	MC230 9124-005	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 5m	EOL [P-Rel]
N/A	10GE	980-9I65Q-00J007	MC230 9124-007	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 7m	EOL [P-Rel]
N/A	10GE	980-9I65R-00J001	MC230 9130-001	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 1m	EOL [HVM]
N/A	10GE	980-9I65S-00J002	MC230 9130-002	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 2m	EOL [HVM]
N/A	10GE	980-9I65T-00J003	MC230 9130-003	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 3m	EOL [HVM]
N/A	10GE	980-9I65U-00J00A	MC230 9130-00A	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 0.5m	EOL [HVM] [HIBERN/ATE]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	10GE	980-9I682-00J004	MC330 9124-004	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 4m	EOL [HVM]
N/A	10GE	980-9I683-00J005	MC330 9124-005	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 5m	EOL [HVM]
N/A	10GE	980-9I684-00J006	MC330 9124-006	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 6m	EOL [HVM]
N/A	10GE	980-9I685-00J007	MC330 9124-007	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 7m	EOL [HVM]
N/A	10GE	980-9I686-00J001	MC330 9130-001	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1m	EOL [HVM]
N/A	10GE	980-9I688-00J002	MC330 9130-002	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2m	EOL [HVM]
N/A	10GE	980-9I68B-00J003	MC330 9130-003	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 3m	EOL [HVM]
N/A	10GE	980-9I68F-00J00A	MC330 9130-00A	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 0.5m	EOL [HVM]
N/A	10GE	980-9I68G-00J01A	MC330 9130-0A1	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1.5m	EOL [HVM]
N/A	10GE	980-9I68H-00J02A	MC330 9130-0A2	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2.5m	EOL [HVM]
N/A	10GE	980-9I68A-	MCP21 00-	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1m, Blue Pulltab,	EOL [HVM] [HIBERN/A]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
		00J001	X001B	Connector Label	TE]
N/A	10GE	980-9I68B-00J002	MCP2100-X002B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2m, Blue Pulltab, Connector Label	EOL [HVM] [HIBERN/A TE]
N/A	10GE	980-9I68C-00J003	MCP2100-X003B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 3m, Blue Pulltab, Connector Label	EOL [HVM]
N/A	10GE	980-9I68E-00J001	MCP2104-X001B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1m, Black Pulltab, Connector Label	EOL [HVM] [HIBERN/A TE]
N/A	10GE	980-9I68F-00J002	MCP2104-X002B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2m, Black Pulltab, Connector Label	EOL [HVM]
N/A	10GE	980-9I68G-00J003	MCP2104-X003B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 3m, Black Pulltab, Connector Label	EOL [HVM]
N/A	10GE	980-9I68H-00J01A	MCP2104-X01AB	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1.5m, Black Pulltab, Connector Label	EOL [HVM]
N/A	10GE	980-9I68I-00J02A	MCP2104-X02AB	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2.5m, Black Pulltab, Connector Label	EOL [HVM]
N/A	10GE	930-90000-0000-343	MFM1T02A-LR	NVIDIA SFP+ optical module for 10GBASE-LR	HVM
N/A	10GE	MFM1T02A-LR-F	MFM1T02A-LR-F	NVIDIA optical module, ETH 10GbE, 10Gb/s, SFP+, LC-LC, 1310nm, LR up to 10km	HVM
N/A	10GE	930-90000-0000-409	MFM1T02A-SR	NVIDIA SFP+ optical module for 10GBASE-SR	HVM

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	10GE	MFM1T0 2A-SR-F	MFM1T 02A-SR- F	NVIDIA optical module, ETH 10GbE, 10Gb/s, SFP+, LC-LC, 850nm, SR up to 300m	HVM
N/A	10GE	MFM1T0 2A-SR-P	MFM1T 02A-SR- P	NVIDIA optical module, ETH 10GbE, 10Gb/s, SFP+, LC-LC, 850nm, SR up to 300m	HVM

## 10GbE Cables

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	10GE	980- 9I71G- 00J000	MAM1 Q00A- QSA	NVIDIA cable module, ETH 10GbE, 40Gb/s to 10Gb/s, QSFP to SFP+	HVM
N/A	10GE	980- 9I65P- 00J005	MC230 9124- 005	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 5m	EOL [P-Rel]
N/A	10GE	980- 9I65Q- 00J007	MC230 9124- 007	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 7m	EOL [P-Rel]
N/A	10GE	980- 9I65R- 00J001	MC230 9130- 001	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 1m	EOL [HVM]
N/A	10GE	980- 9I65S- 00J002	MC230 9130- 002	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 2m	EOL [HVM]
N/A	10GE	980- 9I65T- 00J003	MC230 9130- 003	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 3m	EOL [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	10GE	980-9I65U-00J00A	MC2309130-00A	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 0.5m	EOL [HVM] [HIBERN/ATE]
N/A	10GE	980-9I682-00J004	MC3309124-004	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 4m	EOL [HVM]
N/A	10GE	980-9I683-00J005	MC3309124-005	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 5m	EOL [HVM]
N/A	10GE	980-9I684-00J006	MC3309124-006	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 6m	EOL [HVM]
N/A	10GE	980-9I685-00J007	MC3309124-007	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 7m	EOL [HVM]
N/A	10GE	980-9I686-00J001	MC3309130-001	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1m	EOL [HVM]
N/A	10GE	980-9I688-00J002	MC3309130-002	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2m	EOL [HVM]
N/A	10GE	980-9I68B-00J003	MC3309130-003	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 3m	EOL [HVM]
N/A	10GE	980-9I68F-00J00A	MC3309130-00A	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 0.5m	EOL [HVM]
N/A	10GE	980-9I68G-00J01A	MC3309130-0A1	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1.5m	EOL [HVM]
N/A	10GE	980-9I68H-	MC3309130-	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2.5m	EOL [HVM]

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
		00J02A	0A2		
N/A	10GE	980-9I68A-00J001	MCP2100-X001B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1m, Blue Pulltab, Connector Label	EOL [HVM] [HIBERN/ATE]
N/A	10GE	980-9I68B-00J002	MCP2100-X002B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2m, Blue Pulltab, Connector Label	EOL [HVM] [HIBERN/ATE]
N/A	10GE	980-9I68C-00J003	MCP2100-X003B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 3m, Blue Pulltab, Connector Label	EOL [HVM]
N/A	10GE	980-9I68E-00J001	MCP2104-X001B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1m, Black Pulltab, Connector Label	EOL [HVM] [HIBERN/ATE]
N/A	10GE	980-9I68F-00J002	MCP2104-X002B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2m, Black Pulltab, Connector Label	EOL [HVM]
N/A	10GE	980-9I68G-00J003	MCP2104-X003B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 3m, Black Pulltab, Connector Label	EOL [HVM]
N/A	10GE	980-9I68H-00J01A	MCP2104-X01AB	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1.5m, Black Pulltab, Connector Label	EOL [HVM]
N/A	10GE	980-9I68I-00J02A	MCP2104-X02AB	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2.5m, Black Pulltab, Connector Label	EOL [HVM]
N/A	10GE	930-90000-0000-343	MFM1T02A-LR	NVIDIA SFP+ optical module for 10GBASE-LR	HVM
N/A	10GE	MFM1T02A-LR-F	MFM1T02A-LR-F	NVIDIA optical module, ETH 10GbE, 10Gb/s, SFP+, LC-LC, 1310nm, LR up to 10km	HVM

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	10GE	930-90000-0000-409	MFM1T 02A-SR	NVIDIA SFP+ optical module for 10GBASE-SR	HVM
N/A	10GE	MFM1T0 2A-SR-F	MFM1T 02A-SR-F	NVIDIA optical module, ETH 10GbE, 10Gb/s, SFP+, LC-LC, 850nm, SR up to 300m	HVM
N/A	10GE	MFM1T0 2A-SR-P	MFM1T 02A-SR-P	NVIDIA optical module, ETH 10GbE, 10Gb/s, SFP+, LC-LC, 850nm, SR up to 300m	HVM

## 1GbE Cables

IB Data Rate	Eth Data Rate	NVIDIA P/N	Legacy P/N	Description	LifeCycle Phase
N/A	1GE	980-9I270-00IM00	MC3208 011-SX	NVIDIA Optical module, ETH 1GbE, 1Gb/s, SFP, LC-LC, SX 850nm, up to 500m	EOL [P-Rel]
N/A	1GE	980-9I251-00IS00	MC3208 411-T	NVIDIA module, ETH 1GbE, 1Gb/s, SFP, Base-T, up to 100m	HVM

## Supported 3rd Party Cables and Modules

Speed	Cable OPN	Description
800 GbE	RTXM600-710	800G OSFP to 2x400G QSFP112 AOC (OSFP rev 113.5.0, QSFP rev 6.0.0)

Speed	Cable OPN	Description
800 GbE	DME8821-EC30	OSFP to 2xQSFP112 AOC 800Gb/s to 2x400Gb/s Active Optical Cable (OSFP rev 0.1.0, QSFP rev 32.1.0)
800 GbE	C-OSG8CNSxxx-N00	800G OSFP DR8 to 2x400G QSFP112 DR4 AOC
400 GbE	FCBN950QE1 C05	400G-2x200G split 5M AOC cables (400G QSFP-DD breaking out to 2x 200G QSFP56) (Rev A0)
400 GbE	RTXM600-610	400G QSFP-DDtoQSFP112AOC (Rev 01)
400 GbE	C-GD4CNS010-N00	InnoLight 400G QSFP112 to 400G QSFP-DD active optical cable with full real-time digital diagnostic monitoring (Rev 1A)
400 GbE	DME8811-EC07	400G-2x200G split 7M AOC cables (400G QSFP-DD breaking out to 2x 200G QSFP56) (Rev 12)
400 GbE	RTXM500-910	400G-2x200G split 10M AOC cables (400G QSFP-DD breaking out to 2x 200G QSFP56) (Rev 10)
200 GbE	RTXM500-905	400G-2x200G split 5M AOC cables (400G QSFP-DD breaking out to 2x 200G QSFP56) (Rev C0)
100 GbE	1AT-3Q4M01XX-12A	O-NET QSFP28 100G Active cable/module
100 GbE	AQPMANQ4E DMA0784	QSFP28 100G SMF 500m Transceiver
100 GbE	CAB-Q-Q-100G-3M	Passive 3 meter, QSFP+ to QSFP+ QSFP100 TWINAX 103.125Gbps-CR4
100 GbE	CAB-Q-Q-100GbE-3M	Passive 3 meter , QSFP+ to QSFP+ QSFP100 TWINAX 103.125Gbps-CR4
100 GbE	FCBN425QE1 C30-C1	100GbE Quadwire® QSFP28 Active Optical Cable 30M
100 GbE	FTLC1151RD PL	TRANSCIEVER 100GBE QSFP LR4

Speed	Cable OPN	Description
100 GbE	FTLC9152RG PL	100G 100M QSFP28 SWDM4 OPT TRANS
100 GbE	FTLC9555REP M3-E6	100m Parallel MMF 100GQSFP28Optical Transceiver
100 GbE	NDAAFJ-C102	SF-NDAAFJ100G-005M
100 GbE	QSFP-100G-AOC30M	30m (98ft) Cisco QSFP-100G-AOC30M Compatible 100G QSFP28 Active Optical Cable
100 GbE	QSFP28-LR4-AJ	CISCO-PRE 100GbE LR4 QSFP28 Transceiver Module
100 GbE	SFBR-89BDDZ-CS2	CISCO-PRE 100G AOM BiDi
100 GbE	SQF1002L4L NC101P	Cisco-SUMITOMO 100GbE AOM
40G bE	2231254-2	Cisco 3m 40GbE copper
40G bE	AFBR-7QER15Z-CS1	Cisco 40GbE 15m AOC
40G bE	BN-QS-SP-CBL-5M	PASSIVE COPPER SPLITTER CABLE ETH 40GBE TO 4X10GBE 5M
40G bE	NDCCGJ-C402	15m (49ft) Avago AFBR-7QER15Z Compatible 40G QSFP+ Active Optical Cable
40G bE	QSFP-40G-SR-BD	Cisco 40GBASE-SR-BiDi, duplex MMF

## Supported Cables and Modules for BlueField-2

### Cables Lifecycle Legend

Lifecycle Phase	Definition
EOL	End of Life
LTB	Last Time Buy
HVM	GA level
MP	GA level
P-Rel	GA level
Preliminary	Engineering Sample
Prototype	Engineering Sample

## NDR / 400GbE Cables

Spec'd	Part Number	Marketing Description
400 GE	MCP1660-W001E30	NVIDIA Direct Attach Copper cable, 400GbE, 400Gb/s, QSFP-DD, 1m, 30AWG
400 GE	MCP1660-W002E26	NVIDIA Direct Attach Copper cable, 400GbE, 400Gb/s, QSFP-DD, 2m, 26AWG
400 GE	MCP1660-W003E26	NVIDIA Direct Attach Copper cable, 400GbE, 400Gb/s, QSFP-DD, 3m, 26AWG
400 GE	MCP1660-W00AE30	NVIDIA Direct Attach Copper cable, 400GbE, 400Gb/s, QSFP-DD, 0.5m, 30AWG
400 GE	MCP1660-W01AE30	NVIDIA Direct Attach Copper cable, 400GbE, 400Gb/s, QSFP-DD, 1.5m, 30AWG
400 GE	MCP1660-W02AE26	NVIDIA Direct Attach Copper cable, 400GbE, 400Gb/s, QSFP-DD, 2.5m, 26AWG
400 GE	MCP7F60-W001R30	NVIDIA DAC splitter cable, 400GbE, 400Gb/s to 4x100Gb/s, QSFP-DD to 4xQSFP56, 1m, 30AWG
400 GE	MCP7F60-W002R26	NVIDIA DAC splitter cable, 400GbE, 400Gb/s to 4x100Gb/s, QSFP-DD to 4xQSFP56, 2m, 26AWG

Speed	Part Number	Marketing Description
400 GE	MCP7F60-W02AR26	NVIDIA DAC splitter cable, 400GbE, 400Gb/s to 4x100Gb/s, QSFP-DD to 4xQSFP56, 2.5m, 26AWG
400 GE	MCP7H60-W001R30	NVIDIA DAC splitter cable, 400GbE, 400Gb/s to 2x200Gb/s, QSFP-DD to 2xQSFP56, 1m, 30AWG
400 GE	MCP7H60-W002R26	NVIDIA DAC splitter cable, 400GbE, 400Gb/s to 2x200Gb/s, QSFP-DD to 2xQSFP56, 2m, 26AWG
400 GE	MCP7H60-W01AR30	NVIDIA DAC splitter cable, 400GbE, 400Gb/s to 2x200Gb/s, QSFP-DD to 2xQSFP56, 1.5m, 30AWG
400 GE	MCP7H60-W02AR26	NVIDIA DAC splitter cable, 400GbE, 400Gb/s to 2x200Gb/s, QSFP-DD to 2xQSFP56, 2.5m, 26AWG

## HDR / 200GbE Cables

Speed	Part Number	Marketing Description
200 GE	MFS1S00-V003E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 3m
200 GE	MFS1S00-V005E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 5m
200 GE	MFS1S00-V010E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 10m
200 GE	MFS1S00-V015E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 15m
200 GE	MFS1S00-V020E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 20m
200 GE	MFS1S00-V030E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 30m
200 GE	MFS1S00-V050E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 50m

Speced	Part Number	Marketing Description
200 GE	MFS1S00-V100E	NVIDIA active fiber cable, 200GbE, 200Gb/s, QSFP56, LSZH, black pulltab, 100m
200 GE	MCP1650-V001E30	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 1m, black pulltab, 30AWG
200 GE	MCP1650-V002E26	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 2m, black pulltab, 26AWG
200 GE	MCP1650-V00AE30	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 0.5m, black pulltab, 30AWG
200 GE	MCP1650-V01AE30	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 1.5m, black pulltab, 30AWG
200 GE	MCP1650-V02AE26	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 2.5m, black pulltab, 26AWG
200 GE	MCP7H50-V001R30	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 1m, 30AWG
200 GE	MCP7H50-V002R26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 2m, 26AWG
200 GE	MCP7H50-V01AR30	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 1.5m, 30AWG
200 GE	MCP7H50-V02AR26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 2.5m, 26AWG
200 GE	MMA1T00-VS	NVIDIA transceiver, 200GbE, up to 200Gb/s, QSFP56, MPO, 850nm, SR4, up to 100m
200 GE	MCP1650-V001E30	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 1m, black pulltab, 30AWG
200 GE	MCP1650-V002E26	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 2m, black pulltab, 26AWG
200 GE	MCP1650-V003E26	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 3m, black pulltab, 26AWG
200 GE	MCP1650-V00AE30	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 0.5m, black pulltab, 30AWG

Spec ed	Part Number	Marketing Description
200 GE	MCP1650- V01AE30	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 1.5m, black pulltab, 30AWG
200 GE	MCP1650- V02AE26	NVIDIA Passive Copper cable, 200GbE, 200Gb/s, QSFP56, LSZH, 2.5m, black pulltab, 26AWG
200 GE	MCP7H50- V001R30	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 1m, 30AWG
200 GE	MCP7H50- V002R26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 2m, 26AWG
200 GE	MCP7H50- V003R26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 3m, 26AWG
200 GE	MCP7H50- V01AR30	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 1.5m, 30AWG
200 GE	MCP7H50- V02AR26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 2x100Gb/s, QSFP56 to 2xQSFP56, colored, 2.5m, 26AWG
200 GE	MCP7H70- V001R30	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 4x50Gb/s, QSFP56 to 4xSFP56, colored, 1m, 30AWG
200 GE	MCP7H70- V002R26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 4x50Gb/s, QSFP56 to 4xSFP56, colored, 2m, 26AWG
200 GE	MCP7H70- V003R26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 4x50Gb/s, QSFP56 to 4xSFP56, colored, 3m, 26AWG
200 GE	MCP7H70- V01AR30	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 4x50Gb/s, QSFP56 to 4xSFP56, colored, 1.5m, 30AWG
200 GE	MCP7H70- V02AR26	NVIDIA passive copper hybrid cable, 200GbE 200Gb/s to 4x50Gb/s, QSFP56 to 4xSFP56, colored, 2.5m, 26AWG

## EDR / 100GbE Cables

Speed	Part Number	Marketing Description
100 GbE	MCP1600-C001	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 1m 30AWG
100 GbE	MCP1600-C001E30N	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP28, 1m, black, 30AWG, CA-N
100 GbE	MCP1600-C001LZ	NVIDIA passive copper Cable, ETH 100GbE, 100Gb/s, QSFP, 1m, LSZH, 30AWG
100 GbE	MCP1600-C002	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 2m 30AWG
100 GbE	MCP1600-C002E30N	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP28, 2m, black, 30AWG, CA-N
100 GbE	MCP1600-C003	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 3m 28AWG
100 GbE	MCP1600-C003E26N	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP28, 3m, black, 26AWG, CA-N
100 GbE	MCP1600-C003E30L	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP28, 3m, black, 30AWG, CA-L
100 GbE	MCP1600-C003LZ	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP, 3m, LSZH, 26AWG
100 GbE	MCP1600-C005AM	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP, 5m, 26AWG
100 GbE	MCP1600-C005E26L	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP28, 5m, black, 26AWG, CA-L
100 GbE	MCP1600-C00A	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 0.5m 30AWG
100 GbE	MCP1600-C00AE30N	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP28, 0.5m, black, 30AWG, CA-N
100 GbE	MCP1600-C00BE30N	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP28, 0.75m, black, 30AWG, CA-N
100 GbE	MCP1600-C01A	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 1.5m 30AWG

Speed	Part Number	Marketing Description
100 GbE	MCP1600-C01AE30N	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP28, 1.5m, black, 30AWG, CA-N
100 GbE	MCP1600-C02A	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 2.5m 30AWG
100 GbE	MCP1600-C02AE26N	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP28, 2.5m, black, 26AWG, CA-N
100 GbE	MCP1600-C02AE30L	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP28, 2.5m, black, 30AWG, CA-L
100 GbE	MCP1600-C03A	NVIDIA passive copper cable, ETH 100GbE, 100Gb/s, QSFP, PVC, 3.5m 26AWG
100 GbE	MCP1600-E001	NVIDIA passive copper cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 1m 30AWG
100 GbE	MCP1600-E002	NVIDIA passive copper cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 2m 28AWG
100 GbE	MCP1600-E003	NVIDIA passive copper cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 3m 26AWG
100 GbE	MCP1600-E01A	NVIDIA passive copper cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 1.5m 30AWG
100 GbE	MCP1600-E02A	NVIDIA passive copper cable, IB EDR, up to 100Gb/s, QSFP, LSZH, 2.5m 26AWG
100 GbE	MCP7F00-A001R	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, colored pull-tabs, 1m, 30AWG
100 GbE	MCP7F00-A001R30N	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 1m, colored, 30AWG, CA-N
100 GbE	MCP7F00-A002R	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, colored pull-tabs, 2m, 30AWG
100 GbE	MCP7F00-A002R30N	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 2m, colored, 30AWG, CA-N
100 GbE	MCP7F00-A003R26N	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 3m, colored, 26AWG, CA-N

Speed	Part Number	Marketing Description
100 GbE	MCP7F00-A003R30L	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 3m, colored, 30AWG, CA-L
100 GbE	MCP7F00-A005R26L	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 5m, colored, 26AWG, CA-L
100 GbE	MCP7F00-A01AR	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, colored pull-tabs, 1.5m, 30AWG
100 GbE	MCP7F00-A01AR30N	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 1.5m, colored, 30AWG, CA-N
100 GbE	MCP7F00-A02AR26N	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 2.5m, colored, 26AWG, CA-N
100 GbE	MCP7F00-A02AR30L	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 2.5m, colored, 30AWG, CA-L
100 GbE	MCP7F00-A02ARLZ	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 2.5m, LSZH, colored, 28AWG
100 GbE	MCP7F00-A03AR26L	NVIDIA passive copper hybrid cable, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 3.5m, colored, 26AWG, CA-L
100 GbE	MCP7H00-G001	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 1m, 30AWG
100 GbE	MCP7H00-G001R	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, colored pull-tabs, 1m, 30AWG
100 GbE	MCP7H00-G001R30N	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 1m, colored, 30AWG, CA-N
100 GbE	MCP7H00-G002R	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, colored pull-tabs, 2m, 30AWG
100 GbE	MCP7H00-G002R30N	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 2m, colored, 30AWG, CA-N
100 GbE	MCP7H00-G003R	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, colored pull-tabs, 3m, 28AWG
100 GbE	MCP7H00-G003R26N	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 3m, colored, 26AWG, CA-N

Speed	Part Number	Marketing Description
100 GbE	MCP7H00-G003R30L	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 3m, colored, 30AWG, CA-L
100 GbE	MCP7H00-G004R26L	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 4m, colored, 26AWG, CA-L
100 GbE	MCP7H00-G01AR	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, colored pull-tabs, 1.5m, 30AWG
100 GbE	MCP7H00-G01AR30N	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 1.5m, colored, 30AWG, CA-N
100 GbE	MCP7H00-G02AR	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, colored pull-tabs, 2.5m, 30AWG
100 GbE	MCP7H00-G02AR26N	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 2.5m, colored, 26AWG, CA-N
100 GbE	MCP7H00-G02AR30L	NVIDIA passive copper hybrid cable, ETH 100Gb/s to 2x50Gb/s, QSFP28 to 2xQSFP28, 2.5m, colored, 30AWG, CA-L
100 GbE	MFA1A00-C003	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 3m
100 GbE	MFA1A00-C005	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 5m
100 GbE	MFA1A00-C010	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 10m
100 GbE	MFA1A00-C015	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 15m
100 GbE	MFA1A00-C020	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 20m
100 GbE	MFA1A00-C030	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 30m
100 GbE	MFA1A00-C050	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 50m
100 GbE	MFA1A00-C100	NVIDIA active fiber cable, ETH 100GbE, 100Gb/s, QSFP, LSZH, 100m

Speed	Part Number	Marketing Description
100 GbE	MFA7A20-C003	NVIDIA active fiber hybrid solution, ETH 100GbE to 2x50GbE, QSFP28 to 2xQSFP28, 3m
100 GbE	MFA7A20-C005	NVIDIA active fiber hybrid solution, ETH 100GbE to 2x50GbE, QSFP28 to 2xQSFP28, 5m
100 GbE	MFA7A20-C010	NVIDIA active fiber hybrid solution, ETH 100GbE to 2x50GbE, QSFP28 to 2xQSFP28, 10m
100 GbE	MFA7A20-C020	NVIDIA active fiber hybrid solution, ETH 100GbE to 2x50GbE, QSFP28 to 2xQSFP28, 20m
100 GbE	MFA7A50-C003	NVIDIA active fiber hybrid solution, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 3m
100 GbE	MFA7A50-C005	NVIDIA active fiber hybrid solution, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 5m
100 GbE	MFA7A50-C010	NVIDIA active fiber hybrid solution, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 10m
100 GbE	MFA7A50-C015	NVIDIA active fiber hybrid solution, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 15m
100 GbE	MFA7A50-C020	NVIDIA active fiber hybrid solution, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 20m
100 GbE	MFA7A50-C030	NVIDIA active fiber hybrid solution, ETH 100GbE to 4x25GbE, QSFP28 to 4xSFP28, 30m
100 GbE	MMA1B00-C100D	NVIDIA transceiver, 100GbE, QSFP28, MPO, 850nm, SR4, up to 100m, DDMI
100 GbE	MMA1B00-C100D_FF	NVIDIA transceiver, 100GbE, QSFP28, MPO, 850nm, SR4, up to 100m, DDMI
100 GbE	MMA1L10-CR	NVIDIA optical transceiver, 100GbE, 100Gb/s, QSFP28, LC-LC, 1310nm, LR4 up to 10km
100 GbE	MMA1L30-CM	NVIDIA optical module, 100GbE, 100Gb/s, QSFP28, LC-LC, 1310nm, CWDM4, up to 2km
100 GbE	MMS1C10-CM	NVIDIA active optical module, 100Gb/s, QSFP, MPO, 1310nm, PSM4, up to 500m

## FDR / 56GbE Cables

Speed	Part Number	Marketing Description
56GbE	MC2207126-004	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 4m
56GbE	MC2207128-003	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 3m
56GbE	MC2207128-0A2	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 2.5m
56GbE	MC2207130-001	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 1m
56GbE	MC2207130-002	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 2m
56GbE	MC2207130-00A	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 0.5m
56GbE	MC2207130-0A1	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 1.5m
56GbE	MC220731V-003	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 3m
56GbE	MC220731V-005	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 5m
56GbE	MC220731V-010	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 10m
56GbE	MC220731V-015	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 15m
56GbE	MC220731V-020	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 20m
56GbE	MC220731V-025	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 25m

Speed	Part Number	Marketing Description
56Gb E	MC220731V-030	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 30m
56Gb E	MC220731V-040	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 40m
56Gb E	MC220731V-050	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 50m
56Gb E	MC220731V-075	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 75m
56Gb E	MC220731V-100	NVIDIA active fiber cable, VPI, up to 56Gb/s, QSFP, 100m
56Gb E	MCP1700-F001C	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 1m, Red pull-tab
56Gb E	MCP1700-F001D	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 1m, Yellow pull-tab
56Gb E	MCP1700-F002C	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 2m, Red pull-tab
56Gb E	MCP1700-F002D	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 2m, Yellow pull-tab
56Gb E	MCP1700-F003C	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 3m, Red pull-tab
56Gb E	MCP1700-F003D	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, 3m, Yellow pull-tab
56Gb E	MCP170L-F001	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, LSZH, 1m
56Gb E	MCP170L-F002	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, LSZH, 2m
56Gb E	MCP170L-F003	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, LSZH, 3m
56Gb E	MCP170L-F00A	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, LSZH, 0.5m

Speed	Part Number	Marketing Description
56GbE	MCP170L-F01A	NVIDIA passive copper cable, VPI, up to 56Gb/s, QSFP, LSZH, 1.5m

## 50GbE Cables

Speed	Part Number	Marketing Description
50GbE	MAM1Q00A-QSA56	NVIDIA cable module, ETH 50GbE, 200Gb/s to 50Gb/s, QSFP56 to SFP56
50GbE	MCP2M50-G001E30	NVIDIA Passive Copper cable, 50GbE, 50Gb/s, SFP56, LSZH, 1m, black pulltab, 30AWG
50GbE	MCP2M50-G002E26	NVIDIA Passive Copper cable, 50GbE, 50Gb/s, SFP56, LSZH, 2m, black pulltab, 26AWG
50GbE	MCP2M50-G003E26	NVIDIA Passive Copper cable, 50GbE, 50Gb/s, SFP56, LSZH, 3m, black pulltab, 26AWG
50GbE	MCP2M50-G00AE30	NVIDIA Passive Copper cable, 50GbE, 50Gb/s, SFP56, LSZH, 0.5m, black pulltab, 30AWG
50GbE	MCP2M50-G01AE30	NVIDIA Passive Copper cable, 50GbE, 50Gb/s, SFP56, LSZH, 1.5m, black pulltab, 30AWG
50GbE	MCP2M50-G02AE26	NVIDIA Passive Copper cable, 50GbE, 50Gb/s, SFP56, LSZH, 2.5m, black pulltab, 26AWG

## FDR10 / 40GbE Cables

Speed	Part Number	Marketing Description
40GbE	MC220612-8-004	NVIDIA passive copper cable, VPI, up to 40Gb/s, QSFP, 4m

Speced	Part Number	Marketing Description
40G bE	MC220612 8-005	NVIDIA passive copper cable, VPI, up to 40Gb/s, QSFP, 5m
40G bE	MC220613 0-001	NVIDIA passive copper cable, VPI, up to 40Gb/s, QSFP, 1m
40G bE	MC220613 0-002	NVIDIA passive copper cable, VPI, up to 40Gb/s, QSFP, 2m
40G bE	MC220613 0-003	NVIDIA passive copper cable, VPI, up to 40Gb/s, QSFP, 3m
40G bE	MC220613 0-00A	NVIDIA passive copper cable, VPI, up to 40Gb/s, QSFP, 0.5m
40G bE	MC221012 6-004	NVIDIA passive copper cable, ETH 40GbE, 40Gb/s, QSFP, 4m
40G bE	MC221012 6-005	NVIDIA passive copper cable, ETH 40GbE, 40Gb/s, QSFP, 5m
40G bE	MC221012 8-003	NVIDIA passive copper cable, ETH 40GbE, 40Gb/s, QSFP, 3m
40G bE	MC221013 0-001	NVIDIA passive copper cable, ETH 40GbE, 40Gb/s, QSFP, 1m
40G bE	MC221031 0-003	NVIDIA active fiber cable, ETH 40GbE, 40Gb/s, QSFP, 3m
40G bE	MC221031 0-005	NVIDIA active fiber cable, ETH 40GbE, 40Gb/s, QSFP, 5m
40G bE	MC221031 0-010	NVIDIA active fiber cable, ETH 40GbE, 40Gb/s, QSFP, 10m
40G bE	MC221031 0-015	NVIDIA active fiber cable, ETH 40GbE, 40Gb/s, QSFP, 15m
40G bE	MC221031 0-020	NVIDIA active fiber cable, ETH 40GbE, 40Gb/s, QSFP, 20m
40G bE	MC221031 0-030	NVIDIA active fiber cable, ETH 40GbE, 40Gb/s, QSFP, 30m

Spec'd	Part Number	Marketing Description
40GbE	MC2210310-050	NVIDIA active fiber cable, ETH 40GbE, 40Gb/s, QSFP, 50m
40GbE	MC2210310-100	NVIDIA active fiber cable, ETH 40GbE, 40Gb/s, QSFP, 100m
40GbE	MC2210411-SR4E	NVIDIA optical module, 40Gb/s, QSFP, MPO, 850nm, up to 300m
40GbE	MC2609125-005	NVIDIA passive copper hybrid cable, ETH 40GbE to 4x10GbE, QSFP to 4xSFP+, 5m
40GbE	MC2609130-001	NVIDIA passive copper hybrid cable, ETH 40GbE to 4x10GbE, QSFP to 4xSFP+, 1m
40GbE	MC2609130-003	NVIDIA passive copper hybrid cable, ETH 40GbE to 4x10GbE, QSFP to 4xSFP+, 3m
40GbE	MCP1700-B001E	NVIDIA passive copper cable, ETH 40GbE, 40Gb/s, QSFP, 1m, black pull-tab
40GbE	MCP1700-B002E	NVIDIA passive copper cable, ETH 40GbE, 40Gb/s, QSFP, 2m, black pull-tab
40GbE	MCP1700-B003E	NVIDIA passive copper cable, ETH 40GbE, 40Gb/s, QSFP, 3m, black pull-tab
40GbE	MCP1700-B01AE	NVIDIA passive copper cable, ETH 40GbE, 40Gb/s, QSFP, 1.5m, black pull-tab
40GbE	MCP1700-B02AE	NVIDIA passive copper cable, ETH 40GbE, 40Gb/s, QSFP, 2.5m, black pull-tab
40GbE	MCP7900-X01AA	NVIDIA passive copper hybrid cable, ETH 40GbE to 4x10GbE, QSFP to 4xSFP+, 1.5m, blue pull-tab, customized label
40GbE	MCP7904-X002A	NVIDIA passive copper hybrid cable, ETH 40GbE to 4x10GbE, QSFP to 4xSFP+, 2m, black pull-tab, customized label
40GbE	MCP7904-X003A	NVIDIA passive copper hybrid cable, ETH 40GbE to 4x10GbE, QSFP to 4xSFP+, 3m, black pull-tab, customized label
40GbE	MCP7904-X01AA	NVIDIA passive copper hybrid cable, ETH 40GbE to 4x10GbE, QSFP to 4xSFP+, 1.5m, black pull-tab, customized label

Speed	Part Number	Marketing Description
40GbE	MCP7904-X02AA	NVIDIA passive copper hybrid cable, ETH 40GbE to 4x10GbE, QSFP to 4xSFP+, 2.5m, black pull-tab, customized label
40GbE	MMA1B00-B150D	NVIDIA transceiver, 40GbE, QSFP+, MPO, 850nm, SR4, up to 150m, DDMI

## 25GbE Cables

Speed	Part Number	Marketing Description
25GbE	MAM1Q00A-QSA28	NVIDIA cable module, ETH 25GbE, 100Gb/s to 25Gb/s, QSFP28 to SFP28
25GbE	MCP2M00-A001	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 1m, 30AWG
25GbE	MCP2M00-A001E30N	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 1m, black, 30AWG, CA-N
25GbE	MCP2M00-A002	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 2m, 30AWG
25GbE	MCP2M00-A002E30N	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 2m, black, 30AWG, CA-N
25GbE	MCP2M00-A003E26N	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 3m, black, 26AWG, CA-N
25GbE	MCP2M00-A003E30L	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 3m, black, 30AWG, CA-L
25GbE	MCP2M00-A004E26L	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 4m, black, 26AWG, CA-L
25GbE	MCP2M00-A005E26L	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 5m, black, 26AWG, CA-L
25GbE	MCP2M00-A00A	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 0.5m, 30AWG

Speed	Part Number	Marketing Description
25Gb E	MCP2M00-A00AE30N	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 0.5m, black, 30AWG, CA-N
25Gb E	MCP2M00-A01AE30N	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 1.5m, black, 30AWG, CA-N
25Gb E	MCP2M00-A02AE26N	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 2.5m, black, 26AWG, CA-N
25Gb E	MCP2M00-A02AE30L	NVIDIA passive copper cable, ETH, up to 25Gb/s, SFP28, 2.5m, black, 30AWG, CA-L
25Gb E	MFA2P10-A003	NVIDIA active optical cable 25GbE, SFP28, 3m
25Gb E	MFA2P10-A005	NVIDIA active optical cable 25GbE, SFP28, 5m
25Gb E	MFA2P10-A007	NVIDIA active optical cable 25GbE, SFP28, 7m
25Gb E	MFA2P10-A010	NVIDIA active optical cable 25GbE, SFP28, 10m
25Gb E	MFA2P10-A015	NVIDIA active optical cable 25GbE, SFP28, 15m
25Gb E	MFA2P10-A020	NVIDIA active optical cable 25GbE, SFP28, 20m
25Gb E	MFA2P10-A030	NVIDIA active optical cable 25GbE, SFP28, 30m
25Gb E	MFA2P10-A050	NVIDIA active optical cable 25GbE, SFP28, 50m
25Gb E	MMA2P00-AS	NVIDIA transceiver, 25GbE, SFP28, LC-LC, 850nm, SR, up to 150m

## 10GbE Cables

Speed	Part Number	Marketing Description
10GbE	MAM1Q00A-QSA	NVIDIA cable module, ETH 10GbE, 40Gb/s to 10Gb/s, QSFP to SFP+
10GbE	MC2309124-005	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 5m
10GbE	MC2309124-007	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 7m
10GbE	MC2309130-001	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 1m
10GbE	MC2309130-002	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 2m
10GbE	MC2309130-003	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 3m
10GbE	MC2309130-00A	NVIDIA passive copper hybrid cable, ETH 10GbE, 10Gb/s, QSFP to SFP+, 0.5m
10GbE	MC3309124-004	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 4m
10GbE	MC3309124-005	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 5m
10GbE	MC3309124-006	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 6m
10GbE	MC3309124-007	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 7m
10GbE	MC3309130-001	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1m
10GbE	MC3309130-002	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2m
10GbE	MC3309130-003	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 3m
10GbE	MC3309130-00A	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 0.5m

Speed	Part Number	Marketing Description
10GbE	MC3309130-0A1	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1.5m
10GbE	MC3309130-0A2	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2.5m
10GbE	MCP2100-X001B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1m, blue pull-tab, connector label
10GbE	MCP2100-X002B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2m, blue pull-tab, connector label
10GbE	MCP2100-X003B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 3m, blue pull-tab, connector label
10GbE	MCP2101-X001B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1m, Green pull-tab, connector label
10GbE	MCP2104-X001B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1m, black pull-tab, connector label
10GbE	MCP2104-X002B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2m, black pull-tab, connector label
10GbE	MCP2104-X003B	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 3m, black pull-tab, connector label
10GbE	MCP2104-X01AB	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 1.5m, black pull-tab, connector label
10GbE	MCP2104-X02AB	NVIDIA passive copper cable, ETH 10GbE, 10Gb/s, SFP+, 2.5m, black pull-tab, connector label
N/A	MFM1T02A-LR	NVIDIA SFP+ optical module for 10GBASE-LR
N/A	MFM1T02A-SR	NVIDIA SFP+ optical module for 10GBASE-SR

## 1GbE Cables

Speed	Part Number	Marketing Description
1GbE	MC3208011-SX	NVIDIA optical module, ETH 1GbE, 1Gb/s, SFP, LC-LC, SX 850nm, up to 500m
1GbE	MC3208411-T	NVIDIA module, ETH 1GbE, 1Gb/s, SFP, Base-T, up to 100m

## Release Notes Change Log History

### Changes and New Features in 4.6.0

- Updated minimum UEFI password requirements
- Included DPU BMC firmware as part of the BFB image
- Added virtio-net support for plugging/unplugging parallel devices
- Implemented virtio debug enhancements

### Changes and New Features in 4.5.0

- Added Redfish support for configuring all UEFI secure boot settings (disable, enable, enroll user keys, etc.) at scale, remotely, and securely
- For FHHL DPUs, added support for performing PCIe bifurcation configuration via MFT tool

 **Note**

Only a subset of configurations are supported.

- Updated the print of the manufacturing (MFG) setting, MFG\_OOB\_MAC, displayed by the command bfcfg -d to appear in lower-case to align with standard Linux tools

## Changes and New Features in 4.2.0

### Note

Upgrading to this BSP version installs a new version of Ubuntu GRUB. This version of GRUB revokes the old UEFI secure boot certificates and install new ones. The new certificates will not validate older images and boot will fail. Therefore, to roll back to older software versions, users must disable UEFI secure boot.

- BFB installation chooses the on-chip NVMe (/dev/nvme0n1) by default for the EFI system partition and Linux rootfs installation and can be overloaded with device=/dev/mmcblk0 in bf.cfg to push together with the BFB.

### Info

Installing on NVMe causes DPU booting to stay at the UEFI shell when changing to Livefish mode.

### Info

A previously installed OS on the eMMC device stays intact. Only the EFI boot entry is updated to boot from the SSD device.

## Changes and New Features in 4.0.3

- BlueField-3 tuning update for power and performance

## Changes and New Features in 4.0.2

- BlueField-3 power-capping and thermal-throttling
- Added Linux fsck to boot flow
- Log PCIe errors (to RShim log)
- Halt uncorrectable double-bit ECC error on DDR

## Changes and New Features in 3.9.3

- Added support for live migration of VirtIO-net and VirtIO-blk VFs from one VM to another. Requires working with the new [vDPA driver](#).
- OS configuration – enabled tmpfs in /tmp

## Changes and New Features in 3.9.2

- Added support for Arm host
- Enroll new NVIDIA certificates to DPU UEFI database

### Warning

**Important:** User action required! See known issue #[3077361](#) for details.

## Changes and New Features in 3.9.0

### Note

This is the last release to offer GA support for first-generation NVIDIA® BlueField® DPUs.

- Added support for NIC mode of operation
- Added password protection to change boot parameters in GRUB menu
- Added IB support for DOCA runtime and dev environment
- Implemented RShim PF interrupts
- Virtio-net-controller is split to 2 processes for fast recovery after service restart
- Added support for live virtio-net controller upgrade instead of performing a full restart
- Expanded BlueField-2 PCIe bus number range to 254 (0-253)
- Added a new CAP field, `log_max_queue_depth` (value can be set to 2K/4K), to indicate the maximal NVMe SQ and CQ sizes supported by firmware. This can be used by NVMe controllers or by non-NVMe drivers which do not rely on NVMe CAP field.
- Added ability for the RShim driver to still work when the host is in secure boot mode
- Added `bfb-info` command which provides the breakdown of the software components bundled in the BFB package
- Added support for rate limiting VF groups

## Changes and New Features in 3.8.5

- PXE boot option is enabled automatically and is available for the ConnectX and OOB network interfaces
- Added Vendor Class option "BF2Client" in DHCP request for PXE boot to identify card
- Updated the "force PXE" functionality to continue to retry PXE boot entries until successful. A configuration called "boot override retry" has been added. With this

configured, UEFI does not rebuild the boot entries after all boot options are attempted but loops through the PXE boot options until booting is successful. Once successful, the boot override entry configuration is disabled and would need to be reenabled for future boots.

- Added ability to change the CPU clock dynamically according to the temperature and other sensors of the DPU. If the power consumption reaches close to the maximum allowed, the software module decreases the CPU clock rate to ensure that the power consumption does not cross the system limit.

 **Note**

This feature is relevant only for OPNs MBF2H516C-CESOT, MBF2M516C-EECOT, MBF2H516C-EESOT, and MBF2H516C-CECOT.

- Bug fixes

## Changes and New Features in 3.8.0

- Added ability to perform warm reboot on BlueField-2 based devices
- Added support for DPU BMC with OpenBMC
- Added support for [NVIDIA Converged Accelerator](#) (900-21004-0030-000)

## Bug Fixes History

Ref #	Issue Description
36	Description: Ubuntu kernel 5.15.0-88-generic backports a bug from the upstream kernel which results in virtio-net full emulation not functioning.
60	
46 0	Keywords: Kernel

Ref #	Issue Description
	Fixed in version: 4.6.0
36 95	Description: For BlueField-2, although an option to configure "large ICM size" appears in the UEFI menu it is not functional as large ICM size is not supported on it.
36 7	Keywords: UEFI
	Fixed in version: 4.6.0
35 71 28 5	<p>Description: Intermittent UEFI/grub exception after many power-cycles:</p> <p>Call Stack: Synchronous Exception at 0xF4B72E0C</p> <pre> ERR[UEFI]: PC=0xF4B72E0C ERR[UEFI]: PC=0xF4B72E70 ERR[UEFI]: PC=0xF4B73570 ERR[UEFI]: PC=0xF4B74904 ERR[UEFI]: PC=0xF4F04444 ERR[UEFI]: PC=0xF4F044F8 ERR[UEFI]: PC=0xF4F05160 ERR[UEFI]: PC=0xF4F02030 ERR[UEFI]: PC=0xFDFC3A38 (0xFDFB0000+0x13A38) [ 1] DxeCore.dll ERR[UEFI]: PC=0xF56E3594 (0xF56D4000+0xF594) [ 2] BdsDxe.dll ERR[UEFI]: PC=0xF56F1FFC (0xF56D4000+0x1DFFC) [ 2] BdsDxe.dll ERR[UEFI]: PC=0xF56F40D4 (0xF56D4000+0x200D4) [ 2] BdsDxe.dll ERR[UEFI]: PC=0xFDFC6E50 (0xFDFB0000+0x16E50) [ 3] DxeCore.dll ERR[UEFI]: PC=0x880092E0 ERR[UEFI]: PC=0x8800947C ERR[UEFI]: X0=0x0 X1=0xF4B78FC3 X2=0xE X3=0x0 ERR[UEFI]: X4=0x0 X5=0xFFFFFFFFFFFFFF8 X6=0x0 X7=0xFFFFFFF5 ERR[UEFI]: X8=0xF4B79480 X9=0x2 X10=0xFFFFFFFFFFFFFF X11=0xFFFFDC00 </pre> <p>Keyword: Security</p>
	Fixed in version: 4.5.0

Ref #	Issue Description
35 99	Description: On a reboot following BFB install, the error message "Boot Image update completed, Status: Volume Corrupt" is observed. The error is non-functional and may be safely ignored.
83 9	Keyword: Software provisioning; EFI capsule update; eMMC boot partitions  Fixed in version: 4.5.0
35 56 79 5	Description: The first uplink representor interface may not be renamed to p0 from ethX .  Keyword: Representors  Fixed in version: 4.5.0
36 29 87 5	Description: Fixed base address of static ICM .  Keyword: ICM  Fixed in version: 4.5.0
33 65 36 3	Description: On BlueField-3, when booting virtio-net emulation device using a GRUB2 bootloader, the bootloader may attempt to close and re-open the virtio-net device. This can result in unexpected behavior and possible system failure to boot.  Keywords: BlueField-3; virtio-net; UEFI  Fixed in version: 4.5.0
33 73 84 9	Description: Different OVS-based packages can include their own systemd services which prevents /sbin/mlnx_bf_configure from identifying the right one.  Keywords: OVS; systemd  Fixed in version: 4.5.0
36 05 33 2	Description: A dmseg is printed due to the OVS bridge interface being configured DOWN by default.  Keyword: OVS  Fixed in version: 4.2.1
34 79 04 0	Description: For non-LSO data, a max chain of 4 descriptors is posted onto the send queue resulting in a partial packet going out on the wire.  Keyword: Send; LSO

Ref #	Issue Description
	Fixed in version: 4.2.1
35 49 78 5	Description: NVMe and mlx5_core drivers fail during BFB installation. As a result, Anolis OS cannot be installed on the SSD and the mlxfwreset command does not work during Anolis BFB installation. Keyword: Linux; NVMe; BFB installation
	Fixed in version: 4.2.1
33 93 31 6	Description: When LSO is enabled, if the header and data appear in the same fragment, the following warning is given from tcpdump: truncated-ip - 9 bytes missing Keyword: Virtio-net; large send offload
	Fixed in version: 4.2.1
35 54 12 8	Description: "dmidecode" output does not match "ipmitool fru print" output. Keywords: IPMI; print Fixed in version: 4.2.1
35 08 01 8	Description: Failure to ssh to Arm via 1GbE OOB interface is experienced after performing warm reboot on the DPU. Keywords: SSH; reboot Fixed in version: 4.2.0
34 51 53 9	Description: BSP build number (fourth digit in version number) does not appear in UEFI menu. Keywords: UEFI; software Fixed in version: 4.2.0
32 59 80 5	Description: Following many power cycles on the BlueField DPU, the virtio-net controller may fail to start with the error failed to register epoll in the log. Keywords: Virtio-net; power cycle; epoll Fixed in version: 4.2.0

Ref #	Issue Description
32	Description: Enabled reset on MMC to enhance recovery on error.
66 18	Keywords: MMC; reset
0	Fixed in version: 4.2.0
34 48	Description: The PKA engine is not working on CentOS 7.6 due to multiple OpenSSL versions (1.0.2k 1.1.1k) being installed and the library loader not selecting the correct version of the openssl library.
21 7	Keywords: PKA; OpenSSL
	Fixed in version: 4.2.0
34 48	Description: On virtio-net devices with LSO (large send offload) enabled, bogus packets may be captured on the SF representor when running heavy iperf traffic.
22 8	Keywords: Virtio-net; iperf
	Fixed in version: 4.2.0
34 52	Description: OpenSSL is not working with PKA engine on CentOS 7.6 with 4.23 5.4.10 kernels due to multiple versions of OpenSSL(1.0.2k and 1.1.1k) are installed.
58 3	Keywords: OpenSSL; PKA
	Fixed in version: 4.2.0
34	Description: 699140280000 OPN is not supported.
55 87	Keywords: SKU; support
3	Fixed in version: 4.2.0
35 19	Description: Populate the vGIC maintenance interrupt number in MADT to avoid harmless.
34 1	Keywords: Error
	Fixed in version: 4.2.0
35 22	Description: The timer frequency is measured using the c0 fmon feature causing new kernels to complain if CNTFRQ_EL0 has a different value on different cores.
65 2	Keywords: Timer frequency
	Fixed in version: 4.2.0

Ref #	Issue Description
35 31 96 5	Description: Memory info displayed via dmidecode is not correct for memory sizes 32G and above. Keywords: Memory; dmidecode Fixed in version: 4.2.0
33 62 18 1	Description: A customized BFB with an older kernel does not support bond speed above 200Gb/s. Keywords: Bond; LAG; speed Fixed in version: 4.2.0
31 77 56 9	Description: DCBX configuration may not take effect. Keywords: DCBX; QoS; llDPad Fixed in version: 4.2.0
28 24 85 9	Description: Hotplug/unplug of virtio-net devices during host shutdown/bootup may result in failure to do plug/unplug. Keywords: Virtio-net, hotplug Fixed in version: 4.2.0
32 52 08 3	Description: Assert errors may be observed in the RShim log after reset/reboot. These errors are harmless and may be ignored. Keywords: RShim; log; error Fixed in version: 4.0.3
32 40 06 0	Description: Hotplug of a modern virtio-net device is not supported when VIRTIO_EMULATION_HOTPLUG_TRANS is TRUE from mlxconfig. Keywords: Virtio-net; hotplug; legacy Fixed in version: 4.0.3
32 40 18 2	Description: Virtio-net full emulation is not supported in CentOS 8.2 with inbox-kernel 4.18.0-193.el8.aarch64. Keywords: Virtio-net; CentOS Fixed in version: 4.0.3

Ref #	Issue Description
31 51 88 4	<p>Description: If secure boot is enabled, the following error message is observed while installing Ubuntu on the DPU: ERROR: need to use capsule in secure boot mode . This message is harmless and may be safely ignored.</p> <p>Keywords: Error message; installation</p> <p>Fixed in version: 3.9.3</p>
27 93 00 5	<p>Description: When Arm reboots or crashes after sending a virtio-net unplug request, the hotplugged devices may still be present after Arm recovers. The host, however, will not see those devices.</p> <p>Keywords: Virtio-net; hotplug</p> <p>Fixed in version: 3.9.3</p>
31 07 22 7	<p>Description: BlueField with secured BFB fails to boot up if the PART_SCHEME field is set in bf.cfg during installation.</p> <p>Keywords: Installation; bf.cfg</p> <p>Fixed in version: 3.9.2</p>
31 09 27 0	<p>Description: If the RShim service is running on an external host over the PCIe interface then, in very rare cases, a soft reset of the BlueField can cause a poisoned completion to be returned to the host. The host may treat this as a fatal error and crash.</p> <p>Keywords: RShim; ATF</p> <p>Fixed in version: 3.9.2</p>
27 90 92 8	<p>Description: Virtio-net-controller recovery may not work for a hot-plugged device because the system assigns a BDF (string identifier) of 0 for the hot-plugged device, which is an invalid value.</p> <p>Keywords: Virtio-net; hotplug; recovery</p> <p>Fixed in version: 3.9.0</p>
27 80 81 9	<p>Description: Eye-opening is not supported on 25GbE integrated-BMC BlueField-2 DPU.</p> <p>Keywords: Firmware, eye-opening</p> <p>Fixed in version: 3.9.0</p>

Ref #	Issue Description
28 76 44 7	Description: Virtio full emulation is not supported by NVIDIA® BlueField®-2 multi-host cards.  Keywords: Virtio full emulation; multi-host  Fixed in version: 3.9.0
28 55 48 5	Description: After BFB installation, Linux crash may occur with efi_call_rts messages in the call trace which can be seen from the UART console.  Keywords: Linux crash; efi_call_rts  Fixed in version: 3.9.0
29 01 51 4	Description: Relaxed ordering is not working properly on virtual functions.  Keywords: MLNX_OFED; relaxed ordering; VF  Fixed in version: 3.9.0
28 52 08 6	Description: On rare occasions, the UEFI variables in UVPS EEPROM are wiped out which hangs the boot process at the UEFI menu.  Keywords: UEFI; hang  Fixed in version: 3.9.0
29 34 82 8	Description: PCIe device address to RDMA device name mapping on x86 host may change after the driver restarts in Arm.  Keywords: RDMA; Arm; driver  Fixed in version: 3.9.0
-	Description: RShim driver does not work when the host is in secure boot mode.  Keywords: RShim; Secure Boot  Fixed in version: 3.9.0
27 87 30 8	Description: At rare occasions during Arm reset on BMC-integrated DPUs , the DPU will send "PCIe Completion" marked as poisoned. Some servers treat that as fatal and may hang.  Keywords: Arm reset; BMC integrated  Fixed in version: 3.9.0

Ref #	Issue Description
25 85 60 7	Description: Pushing the BFB image fails occasionally with a "bad magic number" error message showing up in the console.  Keywords: BFB push; installation  Fixed in version: 3.9.0
28 02 94 3	Description: SLD detection may not function properly.  Keywords: Firmware  Fixed in version: 3.9.0
25 80 94 5	Description: External host reboot may also reboot the Arm cores if the DPU was configured using mlxconfig.  Keywords: Non-volatile configuration; Arm; reboot  Fixed in version: 3.9.0
28 99 74 0	Description: BlueField-2 may sometimes go to PXE boot instead of Linux after installation.  Keywords: Installation; PXE  Fixed in version: 3.8.5
28 70 14 3	Description: Some DPUs may get stuck at GRUB menu when booting due to the GRUB configuration getting corrupted when board is powered down before the configuration is synced to memory.  Keywords: GRUB; memory  Fixed in version: 3.8.5
28 73 70 0	Description: The available RShim logging buffer may not have enough space to hold the whole register dump which may cause buffer wraparound.  Keywords: RShim; logging  Fixed in version: 3.8.5
28 01 89 1	Description: IPMI EMU service reports cable link as down when it is actually up.  Keywords: IPMI EMU  Fixed in version: 3.8.0

Ref #	Issue Description
27 79 86 1	Description: Virtio-net controller does not work with devices other than mlx5_0/1. Keywords: Virtio-net controller Fixed in version: 3.8.0
28 01 37 8	Description: No parameter validation is done for feature bits when performing hotplug. Keywords: Virtio-net; hotplug Fixed in version: 3.8.0
28 02 91 7	Description: When secure boot is enabled, PXE boot may not work. Keywords: Secure boot; PXE Fixed in version: 3.8.0
28 27 41 3	Description: Updating a BFB could fail due to congestion. Keywords: Installation; congestion Fixed in version: 3.8.0
28 29 87 6	Description: For virtio-net device, modifying the number of queues does not update the number of MSIX. Keywords: Virtio-net; queues Fixed in version: 3.8.0
25 97 79 0	Description: A "double free" error is seen when using the "curl" utility. This happens only when OpenSSL is configured to use a dynamic engine (e.g. Bluefield PKA engine). Keywords: OpenSSL; curl Fixed in version: 3.8.0
28 53 29 5	Description: UEFI secure boot enables the kernel lockdown feature which blocks access by mstmcra. Keywords: Secure boot Fixed in version: 3.8.0

Ref #	Issue Description
28 54 47 2	Description: Virtio-net controller may fail to start after power cycle. Keywords: Virtio-net controller Fixed in version: 3.8.0
28 54 99 5	Description: Memory consumed for a representor exceeds what is necessary making scaling to 504 SF's not possible. Keywords: Memory Fixed in version: 3.8.0
28 56 65 2	Description: Modifying VF bits yields an error. Keywords: Virtio-net controller Fixed in version: 3.8.0
28 59 06 6	Description: Arm hangs when user is thrown to livefish by FW (e.g. secure boot). Keywords: Arm; livefish Fixed in version: 3.8.0
28 66 08 2	Description: The current installation flow requires multiple resets after booting the self-install BFB due to the watchdog being armed after capsule update. Keywords: Reset; installation Fixed in version: 3.8.0
28 66 53 7	Description: Power-off of BlueField shows up as a panic which is then stored in the RShim log and carried into the BERT table in the next boot which is misleading to the user. Keywords: RShim; log; panic Fixed in version: 3.8.0
28 68 94 4	Description: Various errors related to the UFPS store running out of space are observed. Keywords: UFPS; errors Fixed in version: 3.8.0

Ref #	Issue Description
27 54 79 8	Description: oob_net0 cannot receive traffic after a network restart. Keywords: oob_net0 Fixed in version: 3.8.0
26 91 17 5	Description: Up to 31 hot-plugged virtio-net devices are supported even if PCI_SWITCH_EMULATION_NUM_PORT=32. Host may hang if it hot plugs 32 devices. Keywords: Virtio-net; hotplug Fixed in version: 3.8.0
25 97 97 3	Description: Working with CentOS 7.6, if SF network interfaces are statically configured, the following parameters should be set. NM_CONTROLLED="no" DEVTIMEOUT=30 For example: <pre># cat /etc/sysconfig/network-scripts/ifcfg-p0m0 NAME=p0m0 DEVICE=p0m0 NM_CONTROLLED="no" PEERDNS="yes" ONBOOT="yes" BOOTPROTO="static" IPADDR=12.212.10.29 BROADCAST=12.212.255.255 NETMASK=255.255.0.0 NETWORK=12.212.0.0 TYPE=Ethernet DEVTIMEOUT=30</pre>
	Keywords: CentOS; subfunctions; static configuration
	Fixed in version: 3.7.0
25 81 53 4	Description: When shared RQ mode is enabled and offloads are disabled, running multiple UDP connections from multiple interfaces can lead to packet drops. Keywords: Offload; shared RQ

Ref #	Issue Description
	Fixed in version: 3.7.0
25 81 62 1	Description: When OVS-DPDK and LAG are configured, the kernel driver drops the LACP packet when working in shared RQ mode. Keywords: OVS-DPDK; LAG; LACP; shared RQ
26 01 09 4	Fixed in version: 3.7.0  Description: The gpio-mlxbf2 and mlxbf-gige drivers are not supported on 4.14 kernel. Keywords: Drivers; kernel Fixed in version: 3.7.0
25 84 42 7	Description: Virtio-net-controller does not function properly after changing uplink representor MTU. Keywords: Virtio-net controller; MTU Fixed in version: 3.7.0
24 38 39 2	Description: VXLAN with IPsec crypto offload does not work. Keywords: VXLAN; IPsec crypto Fixed in version: 3.7.0
24 06 40 1	Description: Address Translation Services is not supported in BlueField-2 step A1 devices. Enabling ATS can cause server hang. Keywords: ATS Fixed in version: 3.7.0
24 02 53 1	Description: PHYless reset on BlueField-2 devices may cause the device to disappear. Keywords: PHY; firmware reset Fixed in version: 3.7.0
24 00 38 1	Description: When working with strongSwan 5.9.0bf, running ip xfrm state show returns partial information as to the offload parameters, not showing "mode full". Keywords: strongSwan; ip xfrm; IPsec

Ref #	Issue Description
	Fixed in version: 3.7.0
23 92	Description: Server crashes after configuring PCI_SWITCH_EMULATION_NUM_PORT to a value higher than the number of PCIe lanes the server supports.
60 4	Keywords: Server; hang Fixed in version: 3.7.0
22 93	Description: Loading/reloading NVMe after enabling VirtIO fails with a PCI bar memory mapping error.
79 1	Keywords: VirtIO; NVMe Fixed in version: 3.7.0
22 45	Description: When working with OVS in the kernel and using Connection Tracking, up to 500,000 flows may be offloaded.
98 3	Keywords: DPU; Connection Tracking Fixed in version: 3.7.0
19 45	Description: If the Linux OS running on the host connected to the BlueField DPU has a kernel version lower than 4.14, MLNX_OFED package should be installed on the host.
51 3	Keywords: Host OS Fixed in version: 3.7.0
19	Description: During heavy traffic, ARP reply from the other tunnel endpoint may be dropped. If no ARP entry exists when flows are offloaded, they remain stuck on the slow path.
00 20 3	Workaround: Set a static ARP entry at the BlueField Arm to VXLAN tunnel endpoints. Keywords: ARP; Static; VXLAN; Tunnel; Endpoint Fixed in version: 3.7.0
20 82	Description: During boot, the system enters systemctl emergency mode due a corrupt root file system.
98 5	Keywords: Boot

Ref #	Issue Description
	Fixed in version: 3.6.0.11699
22 78 83 3	Description: Creating a bond via NetworkManager and restarting the driver (openibd restart) results in no pf0hpf and bond creation failure. Keywords: Bond; LAG; network manager; driver reload Fixed in version: 3.6.0.11699
22 86 59 6	Description: Only up to 62 host virtual functions are currently supported. Keywords: DPU; SR-IOV Fixed in version: 3.6.0.11699
23 97 93 2	Description: Before changing SR-IOV mode or reloading the mlx5 drivers on IPsec-enabled systems, make sure all IPsec configurations are cleared by issuing the command ip x s f && ip x p f. Keywords: IPsec; SR-IOV; driver Fixed in version: 3.6.0.11699
24 05 03 9	Description: In Ubuntu, during or after a reboot of the Arm, manually, or as part of a firmware reset, the network devices may not transition to switchdev mode. No device representors would be created (pf0hpf, pf1hpf, etc). Driver loading on the host will timeout after 120 seconds. Keywords: Ubuntu; reboot; representors; switchdev Fixed in version: 3.6.0.11699
24 03 01 9	Description: EEPROM storage for UEFI variables may run out of space and cause various issues such as an inability to push new BFB (due to timeout) or exception when trying to enter UEFI boot menu. Keywords: BFB install; timeout; EEPROM UEFI Variable; UVPS Fixed in version: 3.6.0.11699
24 58 04 0	Description: When using OpenSSL on BlueField platforms where Crypto support is disabled, the following errors may be encountered: PKA_ENGINE: PKA instance is invalid PKA_ENGINE: failed to retrieve valid instance This happens due to OpenSSL configuration being linked to use PKA hardware, but that hardware is not available since crypto support is disabled on these platforms.

Ref #	Issue Description
	Keywords: PKA; Crypto Fixed in version: 3.6.0.11699
24 56	Description: All NVMe emulation counters (Ctrl, SQ, Namespace) return "0" when queried.
94 7	Keywords: Emulated devices; NVMe Fixed in version: 3.6.0.11699
24 11 54	Description: Multi-APP QoS is not supported when LAG is configured. Keywords: Multi-APP QoS; LAG Fixed in version: 3.6.0.11699
23 94 13 0	Description: When creating a large number of VirtIO VFs, hung task call traces may be seen in the dmesg. Keywords: VirtIO; call traces; hang Fixed in version: 3.5.1.11601
23 98 05 0	Description: Only up to 60 virtio-net emulated virtual functions are supported if LAG is enabled. Keywords: Virtio-net; LAG Fixed in version: 3.5.1.11601
22 56 13 4	Description: On rare occasions, rebooting the BlueField DPU may result in traffic failure from the x86 host. Keywords: Host; Arm Fixed in version: 3.5.1.11601
24 00 12 1	Description: When emulated PCIe switch is enabled, and more than 8 PFs are enabled, the BIOS boot process might halt. Keywords: Emulated PCIe switch Fixed in version: 3.5.0.11563
20 82	Description: During boot, the system enters systemctl emergency mode due a corrupt root file system.

Ref #	Issue Description
98 5	Keywords: Boot Fixed in version: 3.5.0.11563
22 49	Description: With the OCP card connecting to multiple hosts, one of the hosts could have the RShim PF exposed and probed by the RShim driver.
18 7	Keywords: RShim; multi-host Fixed in version: 3.5.0.11563
23 63	Description: When moving to separate mode on the DPU, the OVS bridge remains and no ping is transmitted between the Arm cores and the remote server.
65 0	Keywords: SmartNIC; operation modes Fixed in version: 3.5.0.11563
23 94	Description: Pushing the BFB image v3.5 with a WinOF-2 version older than 2.60 can cause a crash on the host side.
22 6	Keywords: Windows; RShim Fixed in version: 3.5.0.11563

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# BlueField Software Overview

NVIDIA provides software which enables users to fully utilize the NVIDIA® BlueField® DPU and enjoy the rich feature-set it provides. Using the BlueField software packages, users can:

- Quickly and easily boot an initial Linux image on your development board
- Port existing applications to and develop new applications for BlueField
- Patch, configure, rebuild, update or otherwise customize your image
- Debug, profile, and tune their development system using open-source development tools taking advantage of the diverse and vibrant Arm ecosystem

Coupled with the NVIDIA® ConnectX® interconnect, the BlueField family of DPU devices includes an array of Arm cores according to the following :

- 64-bit Armv8 A72 for BlueField-2 DPUs
- 64-bit Armv8 A78 for BlueField-3 DPUs

Standard Linux distributions run on the Arm cores allowing common open-source development tools to be used. Developers should find the programming environment familiar and intuitive which in turn allows them to design, implement, and verify their control-plane and data-plane applications quickly and efficiently.

BlueField SW ships with the NVIDIA ® BlueField ® Reference Platform. BlueField SW is a reference Linux distribution based on the Ubuntu Server distribution extended to include the MLNX\_OFED stack for Arm and a Linux kernel which supports NVMe-oF. This software distribution can run all customer-based Linux applications seamlessly.

The following are other software elements delivered with BlueField DPU:

- Arm Trusted Firmware (ATF) for BlueField

- UEFI for BlueField
- OpenBMC for BMC (ASPEED 2500) found on development board
- MLNX\_OFED stack
- Mellanox MFT

## Debug Tools

BlueField DPU includes hardware support for the Arm DS5 suite as well as CoreSight™ debug. As such, a wide range of commercial off-the-shelf Arm debug tools should work seamlessly with BlueField. The CoreSight debugger interface can be accessed via RShim interface (USB or PCIe if using DPU) as well which could be used for debugging with open-source tools like OpenOCD.

The BlueField DPU also supports the ubiquitous GDB.

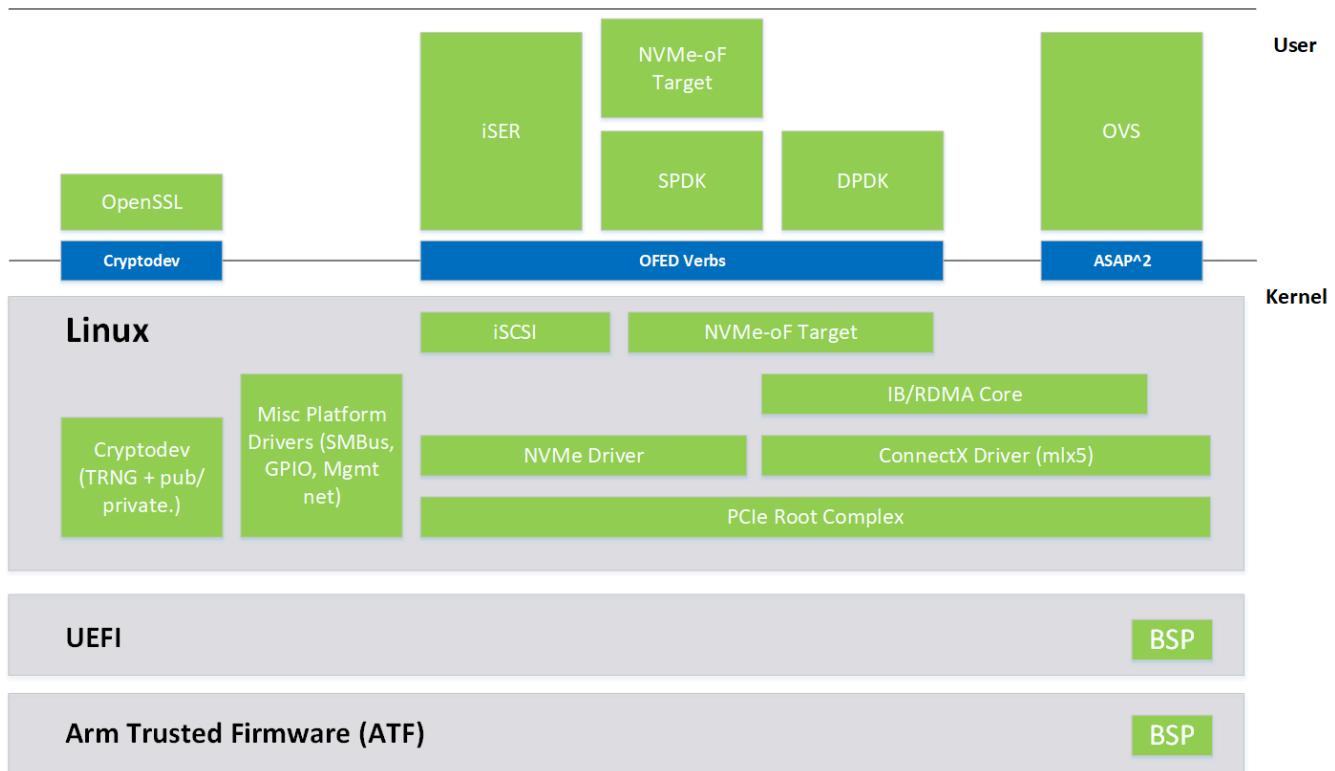
## BlueField-based Storage Appliance

BlueField software provides the foundation for building a JBOF (Just a Bunch of Flash) storage system including NVMe-oF target software, PCIe switch support, NVDIMM-N support, and NVMe disk hot-swap support.

BlueField SW allows enabling ConnectX offload such as RDMA/RoCE, T10 DIF signature offload, erasure coding offload, iSER, Storage Spaces Direct, and more.

## BlueField Architecture

The BlueField architecture is a combination of two preexisting standard off-the-shelf components, Arm AArch64 processors, and ConnectX-6 Dx (for BlueField-2), ConnectX-7 (for BlueField-3), or network controller, each with its own rich software ecosystem. As such, almost any of the programmer-visible software interfaces in BlueField come from existing standard interfaces for the respective components.

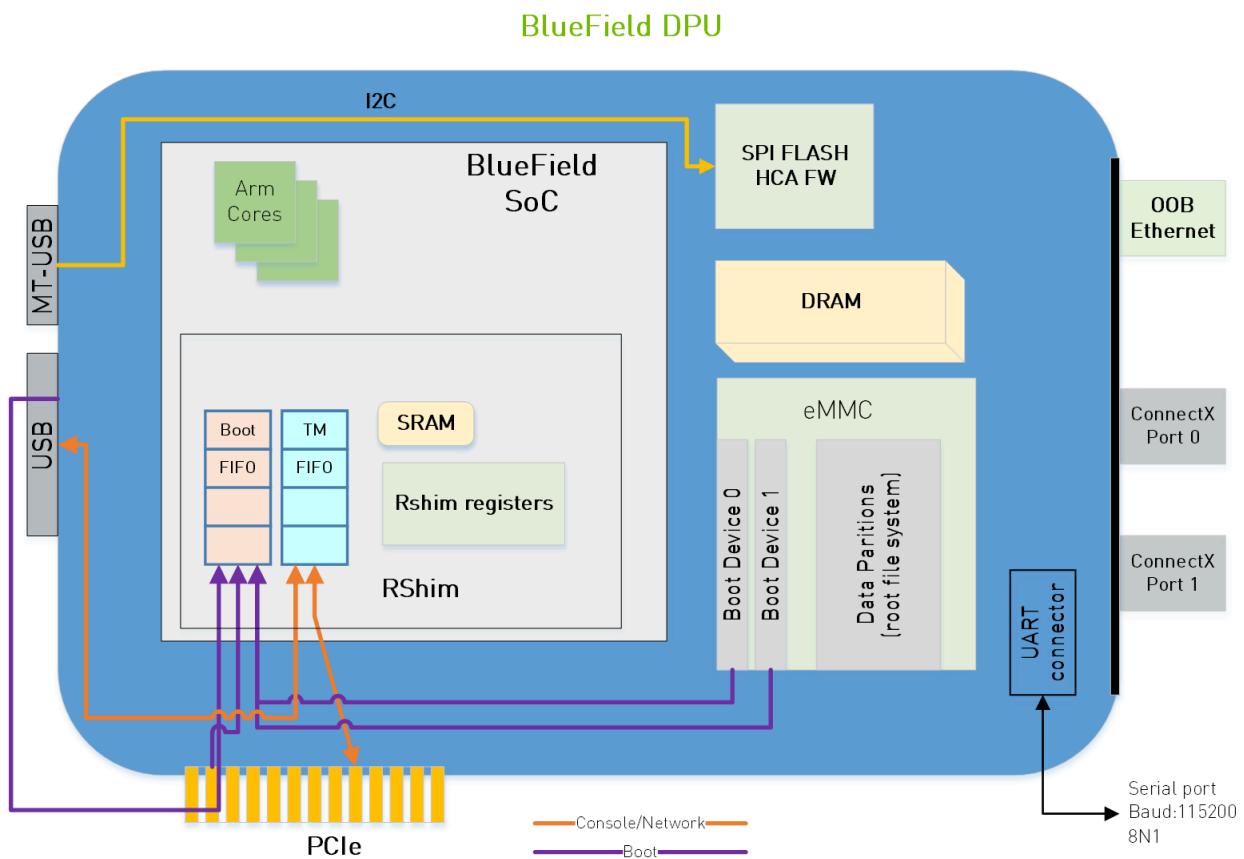


The Arm related interfaces (including those related to the boot process, PCIe connectivity, and cryptographic operation acceleration) are standard Linux on Arm interfaces. These interfaces are enabled by drivers and low-level code provided by NVIDIA as part of the BlueField software delivered and upstreamed to respective open-source projects, such as Linux.

The ConnectX network controller-related interfaces (including those for Ethernet and InfiniBand connectivity, RDMA and RoCE, and storage and network operation acceleration) are identical to the interfaces that support ConnectX standalone network controller cards. These interfaces take advantage of the MLNX\_OFED software stack and InfiniBand verbs-based interfaces to support software.

## System Connections

The BlueField DPU has multiple connections (see diagram below). Users can connect to the system via different consoles, network connections, and a JTAG connector.



## System Consoles

The BlueField DPU has multiple console interfaces:

- Serial console 0 (/dev/ttyAMA0 on the Arm cores)
  - Requires cable to NC-SI connector on DPU 25G
  - Requires serial cable to 3-pin connector on DPU 100G
  - Connected to BMC serial port on BF1200 platforms
- Serial console 1 (/dev/ttyAMA1 on the Arm cores but only for BF1200 reference platform)
  - ttyAMA1 is the console connection on the front panel of the BF1200
- Virtual RShim console (/dev/hvc0 on the Arm cores) is driven by

- The RShim PCIe driver (does not require a cable but the system cannot be in isolation mode as isolation mode disables the PCIe device needed)
- The RShim USB driver (requires USB cable)
- It is not possible to use both the PCIe and USB RShim interfaces at the same time

## Network Interfaces

The DPU has multiple network interfaces.

- ConnectX Ethernet/InfiniBand interfaces
- RShim virtual Ethernet interface (via USB or PCIe)
 

The virtual Ethernet interface can be very useful for debugging, installation, or basic management. The name of the interface on the host DPU server depends on the host operating system. The interface name on the Arm cores is normally "tmfifo\_net0". The virtual network interface is only capable of roughly 10MB/s operation and should not be considered for production network traffic.
- OOB Ethernet interface
 

BlueField-2 based platforms feature an OOB 1GbE management port. This interface provides a 1Gb/s full duplex connection to the Arm cores. The interface name is normally "oob\_net0". The interface enables TCP/IP network connectivity to the Arm cores (e.g., for file transfer protocols, SSH, and PXE boot). The OOB port is not a path for the BlueField-2 boot stream (i.e., any attempt to push a BFB to this port will not work).

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# Software Installation and Upgrade

 **Info**

It is recommended to upgrade your BlueField product to the latest software and firmware versions available to benefit from new features and latest bug fixes.

The NVIDIA® BlueField® DPU is shipped with the BlueField software based on Ubuntu 22.04 pre-installed. The DPU's Arm execution environment has the capability of being functionally isolated from the host server and uses a dedicated network management interface (separate from the host server's management interface). The Arm cores can run the Open vSwitch Database (OVSDB) or other virtual switches to create a secure solution for bare metal provisioning.

The software package also includes support for DPDK as well as applications for accelerated encryption.

The BlueField DPU supports several methods for OS deployment and upgrade:

- Full OS image deployment using a BlueField boot stream file (BFB) via RShim interface

 **Info**

This installation method is compatible with SuperNICs.

- Full OS deployment using PXE which can be used over different network interfaces available on the BlueField DPU (1GbE mgmt, tmfifo or NVIDIA® ConnectX®)
- Individual packages can be installed or upgraded using standard Linux package management tools (e.g., apt, dpkg, etc.)

The DPU's BMC software (i.e., BMC firmware, ERoT firmware, DPU golden image, and NIC firmware golden image) is included in the BFB. The BFB installation updates BMC software components automatically if BMC credentials (i.e., BMC\_USER and BMC\_PASSWORD) are provided in `bf.cfg`.

 **Info**

The minimum BMC Firmware version that supports this method of upgrade from the BlueField is 23.07. If your BMC firmware version is lower, follow the [NVIDIA BlueField BMC Software](#) documentation to upgrade BMC firmware.

 **Info**

Upgrading BlueField software using BFB Bundle now performs NIC firmware update by default.

A reduced size BFB `bf-fwbundle-<version>.prod.bfb` is available for BlueField devices running a customized OS that should not be changed by the BFB installation process. This BFB does not include BlueField OS and can use the same set of `bf.cfg` parameters as a standard BFB with the exception of BlueField OS related flags (e.g., `UPDATE_DPU_OS`).

## Deploying BlueField Software Using BFB from Host

## **Info**

It is recommended to upgrade your BlueField product to the latest software and firmware versions available to benefit from new features and latest bug fixes.

## **Note**

This procedure assumes that a BlueField DPU has already been installed in a server according to the instructions detailed in the [DPU's hardware user guide](#).

The following table lists an overview of the steps required to install Ubuntu BFB on your DPU:

Step	Procedure	Link to Section
1	Uninstall previous DOCA on host (if exists)	<a href="#">Uninstall Previous Software from Host</a>
2	Install RShim on the host	<a href="#">Install RShim on Host</a>
3	Verify that RShim is running on the host	<a href="#">Ensure RShim Running on Host</a>
4	Change the default credentials using bf.cfg file (optional)	<a href="#">Changing Default Credentials Using bf.cfg</a>
5	Install the Ubuntu BFB image	<a href="#">BFB Installation</a>
6	Verify installation completed successfully	<a href="#">Verify BFB is Installed</a>
7	Upgrade the firmware on your DPU	<a href="#">Firmware Upgrade</a>

## **Uninstall Previous Software from Host**

If an older DOCA software version is installed on your host, make sure to uninstall it before proceeding with the installation of the new version:

Ubuntu	host# for f in \$( dpkg --list   grep doca   awk '{print \$2}' ); do echo \$f ; apt remove --purge \$f -y ; done host# sudo apt-get autoremove
CentOS/RHEL	host# for f in \$(rpm -qa  grep -i doca ) ; do yum -y remove \$f; done host# yum autoremove host# yum makecache

## Install RShim on Host

Before installing the RShim driver, verify that the RShim devices, which will be probed by the driver, are listed under lsusb or lspci.

```
lspci | grep -i nox
```

Output example:

```
27:00.0 Ethernet controller: Mellanox Technologies MT42822 BlueField-2 integrated ConnectX-6 Dx network controller
27:00.1 Ethernet controller: Mellanox Technologies MT42822 BlueField-2 integrated ConnectX-6 Dx network controller
27:00.2 Non-Volatile memory controller: Mellanox Technologies NVMe SNAP Controller
27:00.3 DMA controller: Mellanox Technologies MT42822 BlueField-2 SoC Management Interface // This is the RShim PF
```

RShim is compiled as part of the doca-runtime package in the doca-host-repo-ubuntu<version>\_amd64 file (.deb or .rpm).

To install doca-runtime:

OS	Procedure
Ubuntu/Debian	<ol style="list-style-type: none"> <li>1. Download the DOCA Runtime host package from the "<a href="#">Installation Files</a>" section in the <i>NVIDIA DOCA Installation Guide for Linux</i>.</li> <li>2. Unpack the deb repo. Run: <pre data-bbox="502 375 1465 502">host# sudo dpkg -i doca-host-repo-ubuntu&lt;version&gt;.amd64.deb</pre> </li> <li>3. Perform apt update. Run: <pre data-bbox="502 587 1465 633">host# sudo apt-get update</pre> </li> <li>4. Run apt install for DOCA runtime package. <pre data-bbox="502 713 1465 760">host# sudo apt install doca-runtime</pre> </li> </ol>
CentOS/RHEL 7.x	<ol style="list-style-type: none"> <li>1. Download the DOCA runtime host package from the "<a href="#">Installation Files</a>" section in the <i>NVIDIA DOCA Installation Guide for Linux</i>.</li> <li>2. Unpack the RPM repo. Run: <pre data-bbox="502 1009 1465 1094">host# sudo rpm -Uvh doca-host-repo-rhel&lt;version&gt;.x86_64.rpm</pre> </li> <li>3. Enable new yum repos. Run: <pre data-bbox="502 1178 1465 1224">host# sudo yum makecache</pre> </li> <li>4. Run yum install to install DOCA runtime package. <pre data-bbox="502 1326 1465 1372">host# sudo yum install doca-runtime</pre> </li> </ol>
CentOS/RHEL 8.x or Rocky 8.6	<ol style="list-style-type: none"> <li>1. Download the DOCA runtime host package from the "<a href="#">Installation Files</a>" section in the <i>NVIDIA DOCA Installation Guide for Linux</i>.</li> <li>2. Unpack the RPM repo. Run: <pre data-bbox="502 1622 1465 1706">host# sudo rpm -Uvh doca-host-repo-rhel&lt;version&gt;.x86_64.rpm</pre> </li> <li>3. Enable new dnf repos. Run: <pre data-bbox="502 1790 1465 1837">host# sudo dnf makecache</pre> </li> <li>4. Run dnf install to install DOCA runtime.</li> </ol>

OS	Procedure
	host# sudo dnf install doca-runtime

## Ensure RShim Running on Host

1. Verify RShim status. Run:

```
sudo systemctl status rshim
```

Expected output:

```
active (running)
...
Probing pcie-0000:<BlueField's PCIe Bus address on host>
create rshim pcie-0000:<BlueField's PCIe Bus address on host>
rshim<N> attached
```

Where <N> denotes RShim enumeration starting with 0 (then 1, 2, etc.) for every additional DPU installed on the server.

If the text "another backend already attached" is displayed, users will not be able to use RShim on the host. Please refer to "[RShim Troubleshooting and How-Tos](#)" to troubleshoot RShim issues.

1. If the previous command displays inactive or another error, restart RShim service. Run:

```
sudo systemctl restart rshim
```

2. Verify RShim status again. Run:

```
sudo systemctl status rshim
```

If this command does not display "active (running)", then refer to "[RShim Troubleshooting and How-Tos](#)".

2. Display the current setting. Run:

```
# cat /dev/rshim<N>/misc | grep DEV_NAME  
DEV_NAME pcie-0000:04:00.2
```

This output indicates that the RShim service is ready to use.

## Installing Ubuntu on BlueField

### BFB Installation

#### Note

Check the BFB version installed on your BlueField-2 DPU. If the version is 1.5.0 or lower, please see Known Issue Reference #3600716 under [Known Issues](#) section.

#### Info

To upgrade the BMC firmware using BFB, the user must provide the current BMC credentials in the [bf.cfg](#).

#### Note

Upgrading the BlueField networking platform using BFB Bundle updates the NIC firmware by default. NIC firmware upgrade triggers a NIC reset flow via `mlxfwreset` in the BlueField Arm.

If this reset flow cannot complete or is not supported on your setup, bfb-install alerts about it at the end of the installation. In this case, perform a BlueField system reboot for the mlxconfig settings to take effect.

To skip NIC firmware upgrade during BFB Bundle installation , provide the parameter WITH\_NIC\_FW\_UPDATE=no in the bf.cfg text file when running bfb-install .

A pre-built BFB of Ubuntu 22.04 with DOCA Runtime and DOCA packages installed is available on the NVIDIA DOCA SDK developer zone page.

### **Note**

All new BlueField-2 devices and all BlueField-3 are secure boot enabled, hence all the relevant SW images (ATF/UEFI, Linux Kernel and Drivers) must be signed in order to boot. All formally published SW images are signed.

### **Warning**

When installing the BFB bundle in NIC mode, users must perform the following:

1. Prior to installing the BFB bundle, users must unbind each NIC port, using its PCIe function address. For example:

```
host]# lspci -d 15b3:  
21:00.0 Ethernet controller: Mellanox Technologies  
MT43244 BlueField-3 integrated ConnectX-7 network  
controller (rev 01)
```

```
21:00.1 Ethernet controller: Mellanox Technologies  
MT43244 BlueField-3 integrated ConnectX-7 network  
controller (rev 01)  
21:00.2 DMA controller: Mellanox Technologies MT43244  
BlueField-3 SoC Management Interface (rev 01)
```

```
host]# echo 0000:21:00.0 >  
/sys/bus/pci/drivers/mlx5_core/unbind  
host]# echo 0000:21:00.1 >  
/sys/bus/pci/drivers/mlx5_core/unbind
```

If there are multiple BlueField devices to be updated in the server, repeat this step on all of them, before starting BFB bundle installations.

2. After the BFB bundle installation is done, users must perform a warm reboot on the host.

To install Ubuntu BFB, run on the host side:

```
# bfb-install -h  
syntax: bfb-install --bfb | -b <BFBFILE> [--config | -c <bf.cfg>] \  
[--rootfs | -f <rootfs.tar.xz>] --rshim | -r <rshimN> [--help | -h]
```

The bfb-install utility is installed by the RShim package.

This utility script pushes the BFB image and optional configuration (bf.cfg file) to the BlueField side and checks and prints the BFB installation progress. To see the BFB installation progress, please install the pv Linux tool.

## **Warning**

BFB image installation must complete before restarting the system/BlueField. Doing so may result in the BlueField DPU not operating as expected (e.g., it may not be accessible using SSH). If this

happens, re-initiate the update process with bfb-install to recover the DPU.

The following is an output example of Ubuntu 20.04 installation with the bfb-install script assuming pv has been installed.

```
# bfb-install --bfb <BlueField-BSP>.bf --config bf.cfg --rshim rshim0 Pushing bfb +  
cfg  
1.46GiB 0:01:11 [20.9MiB/s] [ <=> ]  
Collecting BlueField booting status. Press Ctrl+C to stop...  
INFO[PSC]: PSC BL1 START  
INFO[BL2]: start  
INFO[BL2]: boot mode (rshim)  
INFO[BL2]: VDDQ: 1120 mV  
INFO[BL2]: DDR POST passed  
INFO[BL2]: UEFI loaded  
INFO[BL31]: start  
INFO[BL31]: lifecycle Production  
INFO[BL31]: MB8: VDD adjustment complete  
INFO[BL31]: VDD: 743 mV  
INFO[BL31]: power capping disabled  
INFO[BL31]: runtime  
INFO[UEFI]: eMMC init  
INFO[UEFI]: eMMC probed  
INFO[UEFI]: UPVS valid  
INFO[UEFI]: PMI: updates started  
INFO[UEFI]: PMI: total updates: 1  
INFO[UEFI]: PMI: updates completed, status 0  
INFO[UEFI]: PCIe enum start  
INFO[UEFI]: PCIe enum end  
INFO[UEFI]: UEFI Secure Boot (disabled)  
INFO[UEFI]: exit Boot Service  
INFO[MISC]: : Found bf.cfg  
INFO[MISC]: : Ubuntu installation started  
INFO[MISC]: bfb_pre_install
```

```
INFO[MISC]: Installing OS image  
INFO[MISC]: : Changing the default password for user ubuntu  
INFO[MISC]: : Running bfb_modify_os from bf.cfg  
INFO[MISC]: : Ubuntu installation finished
```

## Verify BFB is Installed

After installation of the Ubuntu OS is complete, the following note appears in /dev/rshim0/misc on first boot:

```
...  
INFO[MISC]: Linux up  
INFO[MISC]: DPU is ready
```

"DPU is ready" indicates that all the relevant services are up and users can login the system.

After the installation of the Ubuntu 20.04 BFB, the configuration detailed in the following sections is generated.

### Note

Make sure all the services (including cloud-init) are started on BlueField and to perform a graceful shutdown before power cycling the host server.

BlueField OS image version is stored under /etc/mlnx-release in the BlueField:

```
# cat /etc/mlnx-release  
bf-bundle-2.7.0-<version>_ubuntu-22.04_prod
```

# Changing Default Credentials Using bf.cfg

## Info

For a comprehensive list of the supported parameters to customize bf.cfg during BFB installation, refer to section "[bf.cfg Parameters](#)".

Ubuntu users are prompted to change the default password (ubuntu) for the default user (ubuntu) upon first login. Logging in will not be possible even if the login prompt appears until all services are up ("DPU is ready" message appears in /dev/rshim0/misc).

## Note

Attempting to log in before all services are up prints the following message: Permission denied, please try again.

Alternatively, Ubuntu users can provide a unique password that will be applied at the end of the BFB installation. This password must be defined in a bf.cfg configuration file. To set the password for the ubuntu user:

1. Create password hash. Run:

```
# openssl passwd -1  
Password:  
Verifying - Password:
```

```
$1$3B0RlrfX$TlHry93NFUJzg3Nya00rE1
```

2. Add the password hash in quotes to the bf.cfg file:

```
# vim bf.cfg  
ubuntu_PASSWORD='$1$3B0RlrfX$TlHry93NFUJzg3Nya00rE1'
```

The bf.cfg file is used with the bfb-install script in the steps that follow.

## Password Policy

The following table provides the password policy parameters.

Config File Path	Parameter	Value	Description
/etc/security/pwquality.conf	minlen	12	Minimum password length
/etc/pam.d/common-password	remember	3	The number of previous passwords which cannot be reused
/etc/security/faillock.conf	silent	Uncommented	Prevents printing informative messages to the user
	deny	10	The number of authentication attempts permitted before the user is locked out
	unlock_time	600	The duration, in seconds, of the lockout period

### Info

Each of these parameters is configurable in its respective config file indicated in the "Config File Path" column.

## Info

Please refer to the "[Default Passwords and Policies](#)" section for more password policy information.

## GRUB Password Protection

GRUB menu entries are protected by a username and password to prevent unwanted changes to the default boot options or parameters.

The default credentials are as follows:

Username	admin
Password	BlueField

The password can be changed during BFB installation by providing a new `grub_admin_PASSWORD` parameter in `bf.cfg`:

```
# vim bf.cfg
grub_admin_PASSWORD='
grub.pbkdf2.sha512.10000.5EB1FF92FDD89BDAF3395174282C77430656A6DBEC1F92'
```

To get a new encrypted password value use the command `grub-mkpasswd-pbkdf2`.

After the installation, the password can be updated by editing the file /etc/grub.d/40\_custom and then running the command update-grub which updates the file /boot/grub/grub.cfg.

## Firmware Upgrade

To upgrade firmware:

1. Access the BlueField using one of the available interfaces (RShim console, BMC console, SSH via oob\_net0 or tmfifo\_net0 interfaces).
2. Upgrade the firmware on the DPU. Run:

```
sudo /opt/mellanox/mlnx-fw-updater/mlnx_fw_updater.pl --force-fw-update
```

Example output:

```
Device #1:
```

```
-----
```

```
Device Type: BlueField-2
```

```
[...]
```

```
Versions: Current Available
```

```
FW <Old_FW> <New_FW>
```

### Note

**Important!** To apply NVConfig changes, stop here and follow the steps in section "Updating NVConfig Params". In this case, the following step #3 is redundant.

3. Perform a BlueField system reboot for the upgrade to take effect.

## Updating NVConfig Params from Host

1. Optional. To reset the BlueField NIC firmware configuration (aka Nvconfig params) to their factory default values, run the following from the BlueField ARM OS or from the host OS:

```
# sudo mlxconfig -d /dev/mst/<MST device> -y reset  
  
Reset configuration for device /dev/mst/<MST device>? (y/n) [n] : y  
Applying... Done!  
-I- Please reboot machine to load new configurations.
```

 **Note**

For now, please ignore tool's instruction to reboot

 **Note**

To learn what MST device the BlueField DPU has on your setup, run:

```
mst start  
mst status
```

Example output taken on a multiple DPU host:

```
// The MST device corresponds with PCI Bus address.  
  
MST modules:  
-----  
MST PCI module is not loaded  
MST PCI configuration module loaded  
  
MST devices:  
-----  
/dev/mst/mt41692_pciconf0 - PCI configuration cycles  
access.  
domain:bus:dev.fn=0000:03:00.0 addr.reg=88 data.reg=92  
cr_bar.gw_offset=-1  
Chip revision is: 01  
/dev/mst/mt41692_pciconf1 - PCI configuration cycles  
access.  
domain:bus:dev.fn=0000:83:00.0 addr.reg=88 data.reg=92  
cr_bar.gw_offset=-1  
Chip revision is: 01  
/dev/mst/mt41686_pciconf0 - PCI configuration cycles  
access.  
domain:bus:dev.fn=0000:a3:00.0 addr.reg=88 data.reg=92  
cr_bar.gw_offset=-1  
Chip revision is: 01
```

The MST device IDs for the BlueField-2 and BlueField-3 DPUs in this example are /dev/mst/mt41686\_pciconf0 and /dev/mst/mt41692\_pciconf0 respectively.

2. (Optional) Enable NVMe emulation. Run:

```
sudo mlxconfig -d <MST device> -y s NVME_EMULATION_ENABLE=1
```

3. Skip this step if your BlueField DPU is Ethernet only. Please refer to section "Supported Platforms and Interoperability" under the Release Notes to learn your DPU type.

If you have a VPI DPU, the default link type of the ports will be configured to IB. If you want to change the link type to Ethernet, please run the following configuration:

```
sudo mlxconfig -d <MST device> -y s LINK_TYPE_P1=2 LINK_TYPE_P2=2
```

4. Perform a [BlueField system-level reset](#) for the new settings to take effect.

## Customizations During BFB Installation

Using special purpose configuration parameters in the bf.cfg file, the BlueField's boot options and OS can be further customized. For a full list of the supported parameters to customize your DPU system during BFB installation, refer to section "[bf.cfg Parameters](#)". In addition, the bf.cfg file offers further control on customization of BlueField OS installation and software configuration through scripting.

Add any of the following functions to the bf.cfg file for them to be called by the install.sh script embedded in the BFB:

- bfb\_modify\_os – called after the file system is extracted on the target partitions. It can be used to modify files or create new files on the target file system mounted under /mnt. So the file path should look as follows: /mnt/<expected\_path\_on\_target\_OS>. This can be used to run a specific tool from the target OS (remember to add /mnt to the path for the tool).
- bfb\_pre\_install – called before eMMC/SSD partitions format and OS filesystem is extracted
- bfb\_post\_install – called as a last step before reboot. All eMMC/SSD partitions are unmounted at this stage.

For example, the bf.cfg script below disables OVS bridge creation upon boot:

```
# cat /root/bf.cfg

bfb_modify_os()
{
log ===== bfb_modify_os =====
log "Disable OVS bridges creation upon boot"
sed -i -r -e 's/(CREATE_OVS_BRIDGES=).*/\1"no"/' /mnt/etc/mellanox/mlnx-ovs.conf
}

bfb_pre_install()
{
log ===== bfb_pre_install =====
}

bfb_post_install()
{
log ===== bfb_post_install =====
}
```

 **Note**

After modifying files on the BlueField, run the command `sync` to flush file system buffers to eMMC/SSD flash memory to avoid data loss during reboot or power cycle.

## Default Ports and OVS Configuration

The `/sbin/mlnx_bf_configure` script runs automatically with `ib_umad` kernel module loaded (see `/etc/modprobe.d/mlnx-bf.conf`) and performs the following configurations:

1. Ports are configured with switchdev mode and software steering.
2. RDMA device isolation in network namespace is enabled.
3. Two scalable function (SF) interfaces are created (one per port) if BlueField is configured with Embedded CPU mode (default):

```
# mlnx-sf -a show

SF Index: pci/0000:03:00.0/229408
Parent PCI dev: 0000:03:00.0
Representor netdev: en3f0pf0sf0
Function HWADDR: 02:a9:49:7e:34:29
Function trust: off
Function roce: true
Function eswitch: NA
Auxiliary device: mlx5_core.sf.2
netdev: enp3s0f0s0
RDMA dev: mlx5_2

SF Index: pci/0000:03:00.1/294944
Parent PCI dev: 0000:03:00.1
Representor netdev: en3f1pf1sf0
Function HWADDR: 02:53:8f:2c:8a:76
Function trust: off
Function roce: true
Function eswitch: NA
Auxiliary device: mlx5_core.sf.3
netdev: enp3s0f1s0
RDMA dev: mlx5_3
```

The parameters for these SFs are defined in configuration file /etc/mellanox/mlnx-sf.conf.

```
/sbin/mlnx-sf --action create --device 0000:03:00.0 --sfnum 0 --hwaddr
02:61:f6:21:32:8c
/sbin/mlnx-sf --action create --device 0000:03:00.1 --sfnum 0 --hwaddr
02:30:13:6a:2d:2c
```

## Note

To avoid repeating a MAC address in the your network, the SF MAC address is set randomly upon BFB installation. You may choose to configure a different MAC address that better suit your network needs.

4. Two OVS bridges are created:

```
# ovs-vsctl show
f08652a8-92bf-4000-ba0b-7996c772aff6
Bridge ovsbr2
Port ovsbr2
Interface ovsbr2
type: internal
Port p1
Interface p1
Port en3f1pf1sf0
Interface en3f1pf1sf0
Port pf1hp1
Interface pf1hp1
Bridge ovsbr1
Port p0
Interface p0
Port pf0hp1
Interface pf0hp1
Port ovsbr1
Interface ovsbr1
type: internal
Port en3f0pf0sf0
Interface en3f0pf0sf0
ovs_version: "2.14.1"
```

The parameters for these bridges are defined in configuration file /etc/mellanox/mlnx-ovs.conf:

```
CREATE_OVS_BRIDGES="yes"
OVS_BRIDGE1="ovsbr1"
OVS_BRIDGE1_PORTS="p0 pf0hpf en3f0pf0sf0"
OVS_BRIDGE2="ovsbr2"
OVS_BRIDGE2_PORTS="p1 pf1hpf en3f1pf1sf0"
OVS_HW_OFFLOAD="yes"
OVS_START_TIMEOUT=30
```

### Note

If failures occur in /sbin/mlnx\_bf\_configure or configuration changes happen (e.g. switching to separated host mode) OVS bridges are not created even if CREATE\_OVS\_BRIDGES="yes".

5. OVS HW offload is configured.

## Customization of BFB Installation Using bf.cfg

The BFB installation process as well as the content and configuration of the target OS can be customized during BFB installation process using the bf.cfg file. The bf.cfg file is passed to the DPU via RShim or using [PXE](#) configuration and is sourced by BFB's installation script at the beginning of the BFB installation process.

### Info

Information is available under "[bf.cfg Parameters](#)".

A number of helper functions are available in the BFB's install.sh script to enable customization.

- `bfb_modify_os` – the shell function is called after the file system is extracted on the target partitions. It can be used to modify files or create new files on the target file system mounted under `/mnt`. So the file path should look something like the following: `/mnt/<expected_path_on_target_OS>`. This can be used to run a specific tool from the target OS (remember to add `/mnt` to the path for the tool).
- `bfb_pre_install` – the shell function is called before the partitions format and OS filesystem is extracted.
- `bfb_post_install` – the shell function is called as a last step before reboot. All partitions are unmounted at this stage.

The BFB installation process includes the following tasks:

1. Installing target OS if `UPDATE_DPU_OS="yes"` (default)
  1. Creating and formatting partitions on the SSD (default) or EMMC drive.
  2. Extracting target OS file system from the tarball file coming with the BFB.
  3. Configuring target OS depending on the underlying hardware and provided configuration.
  4. Building initramfs for the target OS to make sure all the requirements for boot drivers are included.
2. Updating ATF and UEFI if `UPDATE_ATF_UEFI="yes"` (default).

 **Info**

This is relevant for PXE installation only as ATF and UEFI are updated automatically via RShim.

3. Updating BMC components:

## Info

Requires BMC username and password to be provided.

1. Bringing up VLAN 4040 network interface on top of oob\_net0. VLAN 4040 is configured with static IP 192.168.240.2/29. The timeout for bringing up the connection with the DPU's BMC VLAN 4040 interface (192.168.240.1) is set to BMC\_IP\_TIMEOUT (default is 600 seconds).
2. Updating BMC firmware if a different version is available and UPDATE\_BMC\_FW="yes" (default). The timeout for the BMC firmware update task is BMC\_TASK\_TIMEOUT (default is 1800 seconds).
3. Updating CEC firmware if a different version is available and UPDATE\_CEC\_FW="yes" (default).
4. Updating the DPU golden image if a different version is available and UPDATE\_DPU\_GOLDEN\_IMAGE="yes" (default).
5. Updating the NIC firmware golden image if a different version is available and UPDATE\_NIC\_FW\_GOLDEN\_IMAGE="yes" (default).
6. Rebooting BMC if its firmware was updated and BMC\_REBOOT="yes" (disabled by default).

## Note

BMC reboot is required to apply the new BMC firmware version, but BMC reboot resets the BMC console which is used to monitor the BFB installation process. This is why BMC reboot is disabled by default and should be done after the BFB installation process if using the BMC console.

4. NIC firmware update if WITH\_NIC\_FW\_UPDATE="yes" (default).
5. Reboot.

A complete installation log becomes available on the target file system after the installation process is finished (e.g., /root/Ubuntu.installation.log).

## bf.cfg Parameters

The following is a comprehensive list of the supported parameters to customize the bf.cfg file for BFB installation:

```
#####
# Configuration which can also be set in
# UEFI->Device Manager->System Configuration
#####
# Enable SMMU in ACPI.
#SYS_ENABLE_SMMU = TRUE

# Enable I2C0 in ACPI.
#SYS_ENABLE_I2C0 = FALSE

# Disable SPMI in ACPI.
#SYS_DISABLE_SPMI = FALSE

# Enable the second eMMC card which is only available on the BlueField Reference
Platform.
#SYS_ENABLE_2ND_EMMC = FALSE

# Enable eMMC boot partition protection.
#SYS_BOOT_PROTECT = FALSE

# Enable SPCR table in ACPI.
#SYS_ENABLE_SPCR = FALSE

# Disable PCIe in ACPI.
#SYS_DISABLE_PCIE = FALSE

# Enable OP-TEE in ACPI.
#SYS_ENABLE_OPTEE = FALSE
```

```
#####
# Boot Order configuration
# Each entry BOOT<N> could have the following format:
# PXE:
# BOOT<N> = NET-<NIC_P0 | NIC_P1 | OOB | RSHIM>-<IPV4 | IPV6>
# PXE over VLAN (vlan-id in decimal):
# BOOT<N> = NET-<NIC_P0 | NIC_P1 | OOB | RSHIM>[.<vlan-id>]-<IPV4 | IPV6>
# UEFI Shell:
# BOOT<N> = UEFI_SHELL
# DISK: boot entries created during OS installation.
# BOOT<N> = DISK
#####
# This example configures PXE boot over the 2nd ConnectX port.
# If fails, it continues to boot from disk with boot entries created during OS
# installation.
#BOOT0 = NET-NIC_P1-IPV4
#BOOT1 = DISK

# UPDATE_ATF_UEFI - Updated ATF/UEFI (Default: yes)
# Relevant for PXE installation only as while using RSHIM interface ATF/UEFI
# will always be updated using capsule method
UPDATE_ATF_UEFI="yes"

# UPDATE_DPU_OS - Update/Install DPU Operating System (Default: yes)
UPDATE_DPU_OS="yes"

# grub_admin_PASSWORD - Hashed password to be set for the "admin" user to
# enter Grub menu
# Relevant for Ubuntu BFB only. (Default: is not set)
# E.g.:
grub_admin_PASSWORD='grub.pbkdf2.sha512.10000.5EB1FF92FDD89BDAF339517428'
grub_admin_PASSWORD='grub.pbkdf2.sha512.10000.<hashed password>'

# ubuntu_PASSWORD - Hashed password to be set for "ubuntu" user during BFB
# installation process.
```

```
# Relevant for Ubuntu BFB only. (Default: is not set)
ubuntu_PASSWORD=<hashed password>

#####
# BMC Component Update
#####
# BMC_USER - User name to be used to access BMC (Default: root)
BMC_USER="root"

# BMC_PASSWORD - Password used by the BMC user to access BMC (Default: None)
BMC_PASSWORD=""

# BMC_IP_TIMEOUT - Maximum time in seconds to wait for the connection to the
# BMC to be established (Default: 600)
BMC_IP_TIMEOUT=600

# BMC_TASK_TIMEOUT - Maximum time in seconds to wait for BMC task (BMC/CEC
# Firmware update) to complete (Default: 1800)
BMC_TASK_TIMEOUT=1800

# UPDATE_BMC_FW - Update BMC firmware (Default: yes)
UPDATE_BMC_FW="yes"

# BMC_REBOOT - Reboot BMC after BMC firmware update to apply the new version
# (Default: no). Note that the BMC reboot will reset the BMC console.
BMC_REBOOT="no"

# UPDATE_CEC_FW - Update CEC firmware (Default: yes)
UPDATE_CEC_FW="yes"

# UPDATE_DPU_GOLDEN_IMAGE - Update DPU Golden Image (Default: yes)
UPDATE_DPU_GOLDEN_IMAGE="yes"

# UPDATE_NIC_FW_GOLDEN_IMAGE- Update NIC firmware Golden Image (Default:
yes)
UPDATE_NIC_FW_GOLDEN_IMAGE="yes"
```

```
# pre_bmc_components_update - Shell function called by BFB's install.sh before
# updating BMC components (no communication to the BMC is established at this
# point)

# post_bmc_components_update - Shell function called by BFB's install.sh after
# updating BMC components

#####
# NIC Firmware update
#####
# WITH_NIC_FW_UPDATE - Update NIC Firmware (Default: yes)
WITH_NIC_FW_UPDATE="yes"

#####
# Other misc configuration
#####

# MAC address of the rshim network interface (tmfifo_net0).
#NET_RSHIM_MAC = 00:1a:ca:ff:ff:01

# DHCP class identifier for PXE (arbitrary string up to 32 characters)
#PXE_DHCP_CLASS_ID = NVIDIA/BF/PXE

# Create dual boot partition scheme (Ubuntu only)
# DUAL_BOOT=yes

# Upgrade NIC firmware
# WITH_NIC_FW_UPDATE=yes

# Target storage device for the DPU OS (Default SSD: /dev/nvme0n1)
device=/dev/nvme0n1

# bfb_modify_os - SHELL function called after the file system is extracted on the
target partitions.
```

```
# It can be used to modify files or create new files on the target file system mounted under  
# /mnt. So the file path should look as follows:  
/mnt/<expected_path_on_target_OS>. This  
# can be used to run a specific tool from the target OS (remember to add /mnt to the path for  
# the tool).  
  
# bfb_pre_install – SHELL function called before partitions format  
# and OS filesystem is extracted  
  
# bfb_post_install – SHELL function called as a last step before reboot.  
# All partitions are unmounted at this stage.
```

## Default Network Interface Configuration

Network interfaces are configured using the netplan utility:

```
# cat /etc/netplan/50-cloud-init.yaml  
# This file is generated from information provided by the datasource. Changes  
# to it will not persist across an instance reboot. To disable cloud-init's  
# network configuration capabilities, write a file  
# /etc/cloud/cloud.cfg.d/99-disable-network-config.cfg with the following:  
# network: {config: disabled}  
network:  
ethernets:  
tmfifo_net0:  
addresses:  
- 192.168.100.2/30  
dhcp4: false  
nameservers:  
addresses:  
- 192.168.100.1
```

```
routes:  
- metric: 1025  
to: 0.0.0.0/0  
via: 192.168.100.1  
oob_net0:  
dhcp4: true  
renderer: NetworkManager  
version: 2  
  
# cat /etc/netplan/60-mlnx.yaml  
network:  
ethernets:  
enp3s0f0s0:  
dhcp4: 'true'  
enp3s0f1s0:  
dhcp4: 'true'  
renderer: networkd  
version: 2
```

BlueField DPDUs also have a local IPv6 (LLv6) derived from the MAC address via the STD stack mechanism. For a default MAC, 00:1A:CA:FF:FF:01, the LLv6 address would be fe80::21a:caff:feff:ff01.

For multi-device support, the LLv6 address works with SSH for any number of DPDUs in the same host by including the interface name in the SSH command:

```
host]# systemctl restart rshim  
// wait 10 seconds  
host]# ssh -6 ubuntu@fe80::21a:caff:feff:ff01%tmfifo_net<n>
```

## Note

If tmfifo\_net<n> on the host does not have an LLv6 address, restart the RShim driver:

```
systemctl restart rshim
```

## Ubuntu Boot Time Optimizations

To improve the boot time, the following optimizations were made to Ubuntu OS image:

```
# cat /etc/systemd/system/systemd-networkd-wait-online.service.d/override.conf
[Service]
ExecStart=
ExecStart=/usr/bin/nm-online -s -q --timeout=5

# cat /etc/systemd/system/NetworkManager-wait-online.service.d/override.conf
[Service]
ExecStart=
ExecStart=/usr/lib/systemd/systemd-networkd-wait-online --timeout=5

# cat /etc/systemd/system/networking.service.d/override.conf
[Service]
TimeoutStartSec=5
ExecStop=
ExecStop=/sbin/ifdown -a --read-environment --exclude=lo --force --ignore-errors
```

This configuration may affect network interface configuration if DHCP is used. If a network device fails to get configuration from the DHCP server, then the timeout value in the two files above must be increased.

### Grub Configuration:

Setting the Grub timeout at 2 seconds with GRUB\_TIMEOUT=2 under /etc/default/grub. In conjunction with the GRUB\_TIMEOUT\_STYLE=countdown parameter, Grub will show the countdown of 2 seconds in the console before booting Ubuntu. Please note that, with this short timeout, the standard Grub method for entering the Grub menu (i.e., SHIFT or Esc) does not work. Function key F4 can be used to enter the Grub menu.

## **System Services:**

docker.service is disabled in the default Ubuntu OS image as it dramatically affects boot time.

The kexec utility can be used to reduce the reboot time. Script /usr/sbin/kexec\_reboot is included in the default Ubuntu 20.04 OS image to run corresponding kexec commands.

```
# kexec_reboot
```

## **DHCP Client Configuration**

```
/etc/dhcp/dhclient.conf:  
send vendor-class-identifier "NVIDIA/BF/DP";  
interface "oob_net0" {  
    send vendor-class-identifier "NVIDIA/BF/OOB";  
}
```

## **Ubuntu Dual Boot Support**

BlueField DPU may be installed with support for dual boot. That is, two identical images of the BlueField OS may be installed using BFB.

The following is a proposed SSD partitioning layout for 119.24 GB SSD:

Device	Start	End	Sectors	Size	Type
/dev/nvme0n1p1	2048	104447	102400	50M	EFI System
/dev/nvme0n1p2	104448	114550086	114445639	54.6G	Linux filesystem
/dev/nvme0n1p3	114550087	114652486	102400	50M	EFI System
/dev/nvme0n1p4	114652487	229098125	114445639	54.6G	Linux filesystem
/dev/nvme0n1p5	229098126	250069645	20971520	10G	Linux filesystem

Where:

- /dev/nvme0n1p1 – boot EFI partition for the first OS image

- /dev/nvme0n1p2 – root FS partition for the first OS image
- /dev/nvme0n1p3 – boot EFI partition for the second OS image
- /dev/nvme0n1p4 – root FS partition for the second OS image
- /dev/nvme0n1p5 – common partition for both OS images

For example, the following is a proposed eMMC partitioning layout for a 64GB eMMC:

Device	Start	End	Sectors	Size	Type
/dev/mmcblk0p1	2048	104447	102400	50M	EFI System
/dev/mmcblk0p2	104448	50660334	50555887	24.1G	Linux filesystem
/dev/mmcblk0p3	50660335	50762734	102400	50M	EFI System
/dev/mmcblk0p4	50762735	101318621	50555887	24.1G	Linux filesystem
/dev/mmcblk0p5	101318622	122290141	20971520	10G	Linux filesystem

Where:

- /dev/mmcblk0p1 – boot EFI partition for the first OS image
- /dev/mmcblk0p2 – root FS partition for the first OS image
- /dev/mmcblk0p3 – boot EFI partition for the second OS image
- /dev/mmcblk0p4 – root FS partition for the second OS image
- /dev/mmcblk0p5 – common partition for both OS images

### Note

The common partition can be used to store BFB files that will be used for OS image update on the non-active OS partition.

## Installing Ubuntu OS Image Using Dual Boot

## Note

For software upgrade procedure, please refer to section "[Upgrading Ubuntu OS Image Using Dual Boot](#)".

Add the values below to the bf.cfg configuration file (see section "[bf.cfg Parameters](#)" for more information).

```
DUAL_BOOT=yes
```

If EMMC size is  $\leq$ 16GB, dual boot support is disabled by default, but it can be forced by setting the following parameter in bf.cfg:

```
FORCE_DUAL_BOOT=yes
```

To modify the default size of the /common partition, add the following parameter:

```
COMMON_SIZE_SECTORS=<number-of-sectors>
```

The number of sectors is the size in bytes divided by the block size (512). For example, for 10GB, the COMMON\_SIZE\_SECTORS=\$((\$((10\*2\*\*30)/512))).

After assigning size for the /common partition, what remains is divided equally between the two OS images.

```
# bfb-install --bfb <BFB> --config bf.cfg --rshim rshim0
```

This will result in the Ubuntu OS image to be installed twice on the BlueField DPU.

## Note

For comprehensive list of the supported parameters to customize bf.cfg during BFB installation, refer to section "[bf.cfg Parameters](#)".

## Upgrading Ubuntu OS Image Using Dual Boot

1. Download the new BFB to the BlueField DPU into the /common partition. Use bfb\_tool.py script to install the new BFB on the inactive BlueField DPU partition:

```
/opt/mellanox/mlnx_snap/exec_files/bfb_tool.py --op fw_activate_bfb --bfb  
<BFB>
```

2. Reset BlueField DPU to load the new OS image:

```
/sbin/shutdown -r 0
```

BlueField DPU will now boot into the new OS image.

Use efibootmgr utility to manage the boot order if necessary.

- Change the boot order with:

```
# efibootmgr -o
```

- Remove stale boot entries with:

```
# efibootmgr -b <E> -B
```

Where <E> is the last character of the boot entry (i.e., Boot000<E>). You can find that by running:

```
# efibootmgr
```

```
BootCurrent: 0040
Timeout: 3 seconds
BootOrder: 0040,0000,0001,0002,0003
Boot0000* NET-NIC_P0-IPV4
Boot0001* NET-NIC_P0-IPV6
Boot0002* NET-NIC_P1-IPV4
Boot0003* NET-NIC_P1-IPV6
Boot0040* focal0
....2
```

 **Note**

Modifying the boot order with `efibootmgr -o` does not remove unused boot options. For example, changing a boot order from 0001,0002,0003 to just 0001 does not actually remove 0002 and 0003. 0002 and 0003 need to be explicitly removed using `efibootmgr -B`.

## Deploying BlueField Software Using BFB from BMC

 **Info**

It is recommended to upgrade your BlueField product to the latest software and firmware versions available to benefit from new features and latest bug fixes.

## Note

This section assumes that a BlueField DPU has already been installed in a server according to the instructions detailed in the [DPU's hardware user guide](#).

The following table lists an overview of the steps required to install Ubuntu BFB on your DPU:

Step	Procedure	Direct Link
1	Verify that RShim is already running on BMC	<a href="#">Ensure RShim is Running on BMC</a>
2	Change the default credentials using bf.cfg file (optional)	<a href="#">Changing Default Credentials Using bf.cfg</a>
3	Install the Ubuntu BFB image	<a href="#">BFB Installation</a>
4	Verify installation completed successfully	<a href="#">Verify BFB is Installed</a>
5	Upgrade the firmware on your DPU	<a href="#">Firmware Upgrade</a>

## Note

It is important to learn your BlueField's device-id to perform some of the software installations or upgrades in this guide.

To determine the device ID of the BlueField Platform on your setup, run:

```
host# mst start  
host# mst status -v
```

Example output:

MST modules:

MST PCI module is not loaded

MST PCI configuration module loaded

PCI devices:

DEVICE\_TYPE MST PCI RDMA NET NUMA

BlueField2(rev:1) /dev/mst/mt41686\_pciconf0.1 3b:00.1 mlx5\_1

net-ens1f1 0

BlueField2(rev:1) /dev/mst/mt41686\_pciconf0 3b:00.0 mlx5\_0

net-ens1f0 0

BlueField3(rev:1) /dev/mst/mt41692\_pciconf0.1 e2:00.1

mlx5\_1 net-ens7f1np1 4

BlueField3(rev:1) /dev/mst/mt41692\_pciconf0 e2:00.0

mlx5\_0 net-ens7f0np0 4

0000018f-6041-db75-a1af-f9cb0cbb0003

## Ensure RShim is Running on BMC

Display the current setting. Run:

```
# cat /dev/rshim<N>/misc | grep DEV_NAME
DEV_NAME usb-1.0
```

This output indicates that the RShim service is ready to use. If you do not receive this output:

1. Restart RShim service:

```
sudo systemctl restart rshim
```

2. Verify the current setting again. Run:

```
# cat /dev/rshim<N>/misc | grep DEV_NAME
```

If DEV\_NAME does not appear, then proceed to "[RShim driver not loading on DPU with integrated BMC](#)".

## Changing Default Credentials Using bf.cfg

### Note

For comprehensive list of the supported parameters to customize bf.cfg during BFB installation, refer to section "[bf.cfg Parameters](#)".

Ubuntu users are prompted to change the default password (ubuntu) for the default user (ubuntu) upon first login. Logging in will not be possible even if the login prompt appears until all services are up ("DPU is ready" message appears in /dev/rshim0/misc).

### Note

Attempting to log in before all services are up prints the following message: Permission denied, please try again.

Alternatively, Ubuntu users can provide a unique password that will be applied at the end of the BFB installation. This password must be defined in a bf.cfg configuration file. To set the password for the ubuntu user:

1. Create password hash. Run:

```
# openssl passwd -1  
Password:
```

Verifying - Password:  
\$1\$3B0RlfX\$TlHry93NFUJzg3Nya00rE1

2. Add the password hash in quotes to the bf.cfg file:

```
# vim bf.cfg  
ubuntu_PASSWORD='$1$3B0RlfX$TlHry93NFUJzg3Nya00rE1'
```

The bf.cfg file is used with the bfb-install script in the steps that follow.

## Password Policy

The following table provides the password policy parameters.

Config File Path	Parameter	Value	Description
/etc/security/pwquality.conf	minlen	12	Minimum password length
/etc/pam.d/common-password	remember	3	The number of previous passwords which cannot be reused
/etc/security/faillock.conf	silent	Uncommented	Prevents printing informative messages to the user
	deny	10	The number of authentication attempts permitted before the user is locked out
	unlock_time	600	The duration, in seconds, of the lockout period

### (i) Info

Each of these parameters is configurable in its respective config file indicated in the "Config File Path" column.

## Info

Please refer to the "[Default Passwords and Policies](#)" section for more password policy information.

## BFB Installation

To update the software on the BlueField DPU, the DPU must be booted up without mounting the eMMC flash device. This requires an external boot flow where a BFB (which includes ATF, UEFI, Arm OS, NIC firmware, and initramfs) is pushed from an external host via USB or PCIe. On BlueField DPUs with an integrated BMC, the USB interface is internally connected to the BMC and is enabled by default. Therefore, you must verify that the RShim driver is running on the BMC. This provides the ability to push a bootstream over the USB interface to perform an external boot.

The BFB installation procedure consists of the following main stages:

1. Enabling RShim on the BMC. See section "Enable RShim on DPU BMC" for instructions.
2. Initiating the BFB update procedure by transferring the BFB image using one of the following options:
  - Direct SCP
    - 1. Running an SCP command.
  - Redfish interface
    - 1. Confirming the identity of the host and BMC—required only during first-time setup or after BMC factory reset.
    - 2. Sending a Simple-Update request.

## Transferring BFB Image

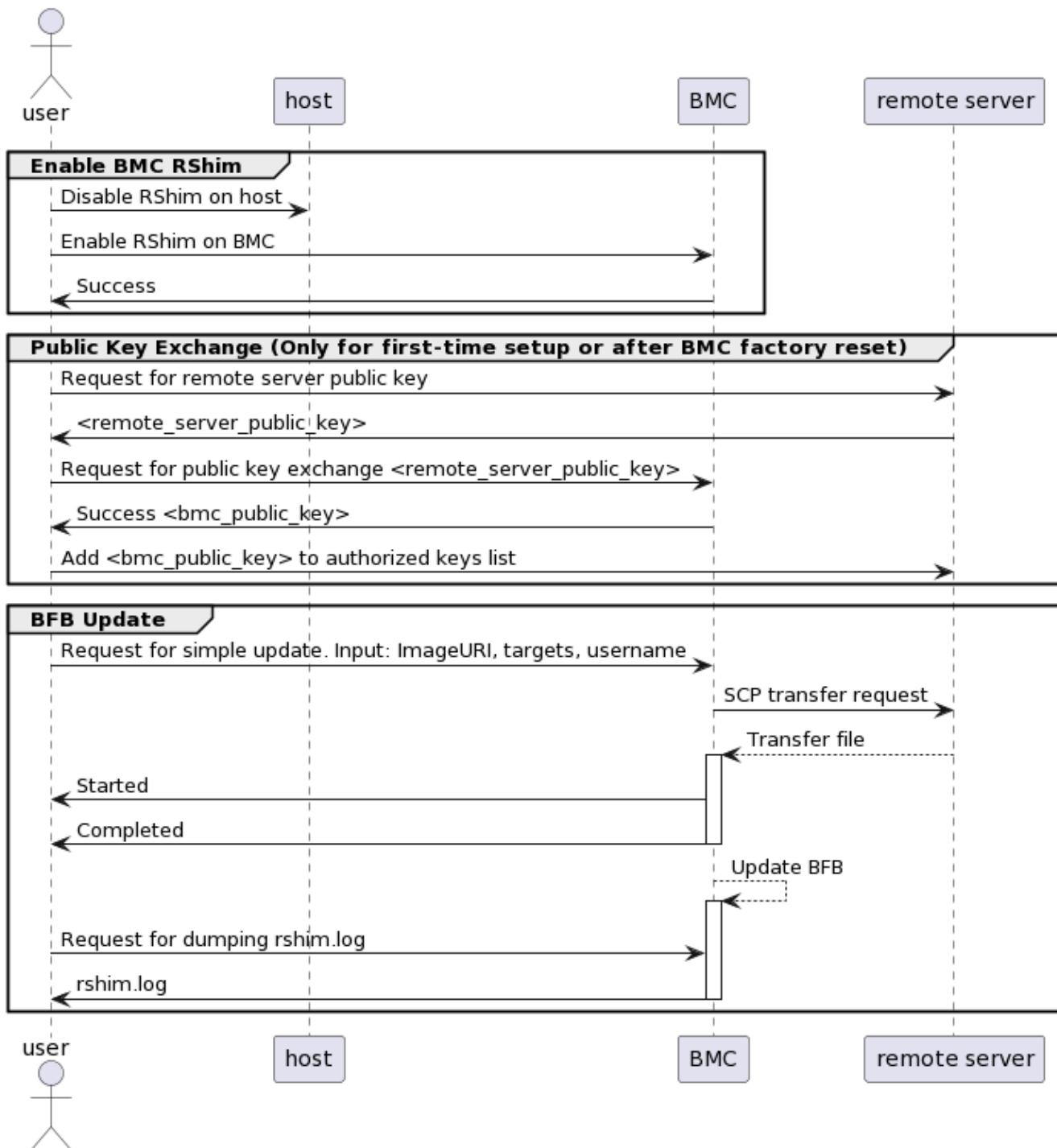
Since the BFB is too large to store on the BMC flash or tmpfs, the image must be written to the RShim device. This can be done by either running SCP directly or using the Redfish

interface.

## **Redfish Interface**

The following is a simple sequence diagram illustrating the flow of the BFB installation process.

## BMC Image Update Flow Using UpdateService POST Command



The following are detailed instructions outlining each step in the diagram:

1. Confirm the identity of the remote server (i.e., host holding the BFB image) and BMC.

## Info

Required only during first-time setup or after BMC factory reset.

1. Run the following on the remote server:

```
ssh-keyscan -t <key_type> <remote_server_ip>
```

Where:

- key\_type – the type of key associated with the server storing the BFB file (e.g., ed25519)
- remote\_server\_ip – the IP address of the server hosting the BFB file

2. Retrieve the public key of the host holding the BFB image from the response and provide the remote server's credentials to the DPU using the following command:

```
curl -k -u root:'<password>' -H "Content-Type: application/json" -X POST -d '{"RemoteServerIP":"<remote_server_ip>", "RemoteServerKeyString":"<remote_server_public_key>"}' https://<bmc_ip>/redfish/v1/UpdateService/Actions/Oem/NvidiaUpdateSer
```

Where:

- remote\_server\_ip – the IP address of the server hosting the BFB file
- remote\_server\_public\_key – remote server's public key from the ssh-keyscan response, which contains both the type and the public key with a space between the two fields (i.e., "<type> <public\_key>").
- bmc\_ip – BMC IP address

3. Extract the BMC public key information (i.e., "<type> <bmc\_public\_key> <username>@<hostname>") from the PublicKeyExchange response and append it to the authorized\_keys file on the host holding the BFB image. This enables passwordless key-based authentication for users.

```
{  
"@Message.ExtendedInfo": [
```

```
{
  "@odata.type": "#Message.v1_1_1.Message",
  "Message": "Please add the following public
key info to ~/.ssh/authorized_keys on the
remote server",
  "MessageArgs": [
    "<type> <bmc_public_key> root@dpu-bmc"
  ],
},
{
  "@odata.type": "#Message.v1_1_1.Message",
  "Message": "The request completed
successfully.",
  "MessageArgs": [],
  "MessageId": "Base.1.15.0.Success",
  "MessageSeverity": "OK",
  "Resolution": "None"
}
]
```

4. If the remote server public key must be revoked, use the following command before repeating the previous step:

```
curl -k -u root:'<password>' -H "Content-Type: application/json" -X POST -
d '{"RemoteServerIP":"<remote_server_ip>"'
https://<bmc_ip>/redfish/v1/UpdateService/Actions/Oem/NvidiaUpdateSer
```

Where:

- `remote_server_ip` – remote server's IP address
- `bmc_ip` – BMC IP address

2. Start BFB image transfer using the following command on the remote server:

```
curl -k -u root:'<password>' -H "Content-Type: application/json" -X POST -d
'{"TransferProtocol":"SCP", "ImageURI":"<image_uri>","Targets":
["redfish/v1/UpdateService/FirmwareInventory/DPU_OS"], "Username": "
```

```
<username>"}  
https://<bmc_ip>/redfish/v1/UpdateService/Actions/UpdateService.SimpleUpdate
```

### Info

After the BMC boots, it may take a few seconds (6-8 in NVIDIA® BlueField®-2, and 2 in BlueField-3) until the DPU BSP (DPU\_OS) is up.

### Note

This command uses SCP for the image transfer, initiates a soft reset on the BlueField and then pushes the boot stream. For Ubuntu BFBs, the eMMC is flashed automatically once the bootstream is pushed. On success, a "running" message is received with the current task ID.

Where:

- image\_uri – the image URI format should be  
`<remote_server_ip>/<path_to_bfb>`
- username – username on the remote server
- bmc\_ip – BMC IP address

Examples:

- If RShim is disabled:

```
{  
  "error": {  
    "@Message.ExtendedInfo": [  
      {
```

```

    "@odata.type": "#Message.v1_1_1.Message",
    "Message": "The requested resource of type Target named
    '/dev/rshim0/boot' was not found.",
    "MessageArgs": [
        "Target",
        "/dev/rshim0/boot"
    ],
    "MessageId": "Base.1.15.0.ResourceNotFound",
    "MessageSeverity": "Critical",
    "Resolution": "Provide a valid resource identifier and resubmit
    the request."
}
],
{
    "code": "Base.1.15.0.ResourceNotFound",
    "message": "The requested resource of type Target named
    '/dev/rshim0/boot' was not found."
}

```

- If a username or any other required field is missing:

```

{
    "Username@Message.ExtendedInfo": [
    {
        "@odata.type": "#Message.v1_1_1.Message",
        "Message": "The create operation failed because the required
        property Username was missing from the request.",
        "MessageArgs": [
            "Username"
        ],
        "MessageId": "Base.1.15.0.CreateFailedMissingReqProperties",
        "MessageSeverity": "Critical",
        "Resolution": "Correct the body to include the required property
        with a valid value and resubmit the request if the operation failed."
    }
]
}

```

- If the request is valid and a task is created:

```
{  
  "@odata.id":  
    "/redfish/v1/TaskService/Tasks/<task_id>",  
  "@odata.type": "#Task.v1_4_3.Task",  
  "Id": "<task_id>",  
  "TaskState": "Running",  
  "TaskStatus": "OK"  
}
```

3. Wait 2 seconds and run the following on the host to track image transfer progress:

```
curl -k -u root:'<password>' -X GET  
https://<bmc_ip>/redfish/v1/TaskService/Tasks/<task_id>
```

### Note

The transfer takes ~8 minutes for BlueField-3, and ~40 minutes for BlueField-2. During the transfer, the PercentComplete value remains at 0. If no errors occur, the TaskState is set to Running, and a keep-alive message is generated every 5 minutes with the content "Transfer is still in progress (X minutes elapsed). Please wait". Once the transfer is completed, the PercentComplete is set to 100, and the TaskState is updated to Completed.

Upon failure, a message is generated with the relevant resolution.

Where:

1. bmc\_ip – BMC IP address
2. task\_id – task ID

## Troubleshooting:

- If host identity is not confirmed or the provided host key is wrong:

```
{  
  "@odata.type": "#MessageRegistry.v1_4_1.MessageRegistry",  
  "Message": "Transfer of image '<file_name>' to '/dev/rshim0/boot'  
  failed.",  
  "MessageArgs": [  
    "<file_name>",  
    "/dev/rshim0/boot"  
  ],  
  "MessageId": "Update.1.0.TransferFailed",  
  "Resolution": " Unknown Host: Please provide server's public key  
  using PublicKeyExchange ",  
  "Severity": "Critical"  
}  
...  
"PercentComplete": 0,  
"StartTime": "<start_time>",  
"TaskMonitor": "/redfish/v1/TaskService/Tasks/<task_id>/Monitor",  
"TaskState": "Exception",  
"TaskStatus": "Critical"
```

### Info

In this case, revoke the remote server key ([step 1.d.](#)),  
and repeat steps 1.a. to 1.c.

- If the BMC identity is not confirmed:

```
{
```

```
"@odata.type": "#MessageRegistry.v1_4_1.MessageRegistry",
"Message": "Transfer of image '<file_name>' to '/dev/rshim0/boot' failed.",
"MessageArgs": [
    "<file_name>",
    "/dev/rshim0/boot"
],
"MessageId": "Update.1.0.TransferFailed",
"Resolution": "Unauthorized Client: Please use the PublicKeyExchange action to receive the system's public key and add it as an authorized key on the remote server",
"Severity": "Critical"
}
...
"PercentComplete": 0,
"StartTime": "<start_time>",
"TaskMonitor": "/redfish/v1/TaskService/Tasks/<task_id>/Monitor",
"TaskState": "Exception",
"TaskStatus": "Critical"
```

## Info

In this case, verify that the BMC key has been added correctly to the `authorized_key` file on the remote server.

- If SCP fails:

```
{
"@odata.type": "#MessageRegistry.v1_4_1.MessageRegistry",
"Message": "Transfer of image '<file_name>' to '/dev/rshim0/boot' failed.",
"MessageArgs": [
    "<file_name>",
```

```

"/dev/rshim0/boot"
],
"MessageId": "Update.1.0.TransferFailed",
"Resolution": "Failed to launch SCP",
"Severity": "Critical"
}

...
"PercentComplete": 0,
"StartTime": "<start_time>",
"TaskMonitor": "/redfish/v1/TaskService/Tasks/<task_id>/Monitor",
"TaskState": "Exception",
"TaskStatus": "Critical"

```

- The keep-alive message:

```

{
"@odata.type": "#MessageRegistry.v1_4_1.MessageRegistry",
"Message": "<file_name>' is being transferred to
'/dev/rshim0/boot'.",
"MessageArgs": [
" <file_name>",
"/dev/rshim0/boot"
],
"MessageId": "Update.1.0.TransferringToComponent",
"Resolution": "Transfer is still in progress (5 minutes elapsed):
Please wait",
"Severity": "OK"
}
...
"PercentComplete": 0,
"StartTime": "<start_time>",
"TaskMonitor": "/redfish/v1/TaskService/Tasks/<task_id>/Monitor",
"TaskState": "Running",
"TaskStatus": "OK"

```

- Upon completion of transfer of the BFB image to the DPU, the following is received:

```
{  
    "@odata.type": "#MessageRegistry.v1_4_1.MessageRegistry",  
    "Message": "Device 'DPU' successfully updated with image  
    '<file_name>'.",  
    "MessageArgs": [  
        "DPU",  
        "<file_name>"  
    ],  
    "MessageId": "Update.1.0.UpdateSuccessful",  
    "Resolution": "None",  
    "Severity": "OK"  
},  
...  
"PercentComplete": 100,  
"StartTime": "<start_time>",  
"TaskMonitor": "/redfish/v1/TaskService/Tasks/<task_id>/Monitor",  
"TaskState": "Completed",  
"TaskStatus": "OK"
```

- When the BFB transfer is complete, dump the current RShim miscellaneous messages to check the update status.

 **Info**

Refer to section "BMC Dump Operations" under "BMC and BlueField Logs" for information on dumping the rshim.log which contains the current RShim miscellaneous messages.

- Verify that the new BFB is running by checking its version:

```
curl -k -u root:'<password>' -H "Content-Type: application/json" -X GET
```

```
https://<bmc_ip>/redfish/v1/UpdateService/FirmwareInventory/DPU_OS
```

## Direct SCP

```
scp <path_to_bfb> root@<bmc_ip>:/dev/rshim0/boot
```

If bf.cfg is required as part of the boot process, run:

```
cat <path_to_bfb> bf.cfg > new.bfb  
scp <path to new.bfb> root@<bmc_ip>:/dev/rshim0/boot
```

### (i) Note

For comprehensive list of the supported parameters to customize bf.cfg during BFB installation, refer to section "[bf.cfg Parameters](#)".

## Verify BFB is Installed

After installation of the Ubuntu OS is complete, the following note appears in /dev/rshim0/misc on first boot:

```
...  
INFO[MISC]: Linux up  
INFO[MISC]: DPU is ready
```

"DPU is ready" indicates that all the relevant services are up and users can login the system.

After the installation of the Ubuntu 20.04 BFB, the configuration detailed in the following sections is generated.

## Note

Make sure all the services (including cloud-init) are started on BlueField and to perform a graceful shutdown before power cycling the host server.

BlueField OS image version is stored under `/etc/mlnx-release` in the BlueField:

```
# cat /etc/mlnx-release  
bf-bundle-2.7.0-<version>_ubuntu-22.04_prod
```

## Firmware Upgrade

To upgrade firmware:

1. Access the BlueField using one of the available interfaces (RShim console, BMC console, SSH via `oob_net0` or `tmfifo_net0` interfaces).
2. Upgrade the firmware on the DPU. Run:

```
sudo /opt/mellanox/mlnx-fw-updater/mlnx_fw_updater.pl --force-fw-update
```

Example output:

```
Device #1:  
-----
```

```
Device Type: BlueField-2  
[...]  
Versions: Current Available  
FW <Old_FW> <New_FW>
```

**(i) Note**

**Important!** To apply NVConfig changes, stop here and follow the steps in section "Updating NVConfig Params". In this case, the following step #3 is redundant.

3. Perform a BlueField system reboot for the upgrade to take effect.

## Updating NVConfig Params

1. Optional. To reset the BlueField NIC firmware configuration (aka Nvconfig params) to their factory default values, run the following from the BlueField ARM OS or from the host OS:

```
# sudo mlxconfig -d /dev/mst/<MST device> -y reset
```

Reset configuration for device /dev/mst/<MST device>? (y/n) [n] : y

Applying... Done!

-I- Please reboot machine to load new configurations.

**(i) Note**

For now, please ignore tool's instruction to reboot

**(i) Note**

To learn what MST device the BlueField DPU has on your setup, run:

```
mst start  
mst status
```

Example output taken on a multiple DPU host:

```
// The MST device corresponds with PCI Bus address.
```

MST modules:

```
-----  
MST PCI module is not loaded
```

```
MST PCI configuration module loaded
```

MST devices:

```
-----  
/dev/mst/mt41692_pciconf0 - PCI configuration cycles  
access.
```

```
domain:bus:dev.fn=0000:03:00.0 addr.reg=88 data.reg=92  
cr_bar.gw_offset=-1
```

```
Chip revision is: 01
```

```
/dev/mst/mt41692_pciconf1 - PCI configuration cycles  
access.
```

```
domain:bus:dev.fn=0000:83:00.0 addr.reg=88 data.reg=92  
cr_bar.gw_offset=-1
```

```
Chip revision is: 01
```

```
/dev/mst/mt41686_pciconf0 - PCI configuration cycles  
access.
```

```
domain:bus:dev.fn=0000:a3:00.0 addr.reg=88 data.reg=92  
cr_bar.gw_offset=-1
```

```
Chip revision is: 01
```

The MST device IDs for the BlueField-2 and BlueField-3 DPUs in this example are /dev/mst/mt41686\_pciconf0 and /dev/mst/mt41692\_pciconf0 respectively.

2. (Optional) Enable NVMe emulation. Run:

```
sudo mlxconfig -d <MST device> -y s NVME_EMULATION_ENABLE=1
```

3. Skip this step if your BlueField DPU is Ethernet only. Please refer to section "Supported Platforms and Interoperability" under the Release Notes to learn your DPU type.

If you have a VPI DPU, the default link type of the ports will be configured to IB. If you want to change the link type to Ethernet, please run the following configuration:

```
sudo mlxconfig -d <MST device> -y s LINK_TYPE_P1=2 LINK_TYPE_P2=2
```

4. Perform a [BlueField system-level reset](#) for the new settings to take effect.

## Deploying BlueField Software Using BFB with PXE

### Info

It is recommended to upgrade your BlueField product to the latest software and firmware versions available to benefit from new features and latest bug fixes.

### Note

PXE installation is not supported for NIC mode on NVIDIA® BlueField®-3.

## PXE Server Preparations

1. Provide the image from BFB file. Run:

```
# mlx-mkbfb -x <BFB>
```

For example:

```
# mlx-mkbfb -x DOCA_2.6.0_BSP_4.6.0_Ubuntu_22.04-<version>.bfb
```

 **Note**

mlx-mkbfb is a Python script that can be found in BlueField release tarball under the /bin directory or in the BlueField Arm file system /usr/bin/mlx-mkbfb.

2. Copy the 2 dumped files, dump-image-v0 and dump-initramfs-v0 into the PXE server tftp path.

3. In the PXE server create a boot entry. For example:

```
/var/lib/tftpboot/grub.cfg

set default=0
set timeout=5
menuentry 'Bluefield_Ubuntu_22_04_From_BFB' --class red --class gnu-linux --
class gnu --class os {
    linux (tftp)/ubuntu22.04/dump-image-v0 ro ip=dhcp console=hvc0
    console=ttyAMA0
    initrd (tftp)/ubuntu22.04/dump-initramfs-v0
}
```

If additional parameters must be set, use the bf.cfg configuration file, then add the bfks parameter to the Linux command line in the grub.cfg above.

```
menuentry 'Ubuntu22.04 From BFB with bf.cfg' --class red --class gnu-linux --  
class gnu --class os {  
    linux (tftp)/ubuntu22.04/dump-image-v0 console=hvc0 console=ttyAMA0  
    bfnet=oob_net0:dhcp bfks=http://15.22.82.40/bfks  
    initrd (tftp)/ubuntu22.04/dump-initramfs-v0  
}
```

Where bfks is a BASH script that will run by BFB's install.sh script at the beginning of the BFB installation process. Here is an example of bfks that creates a /etc/bf.cfg file:

```
cat > /etc/bf.cfg << 'EOF'  
DEBUG=yes  
ubuntu_PASSWORD='$1$3B0RlrfX$TlHry93NFUJzg3Nya00rE1'  
EOF
```

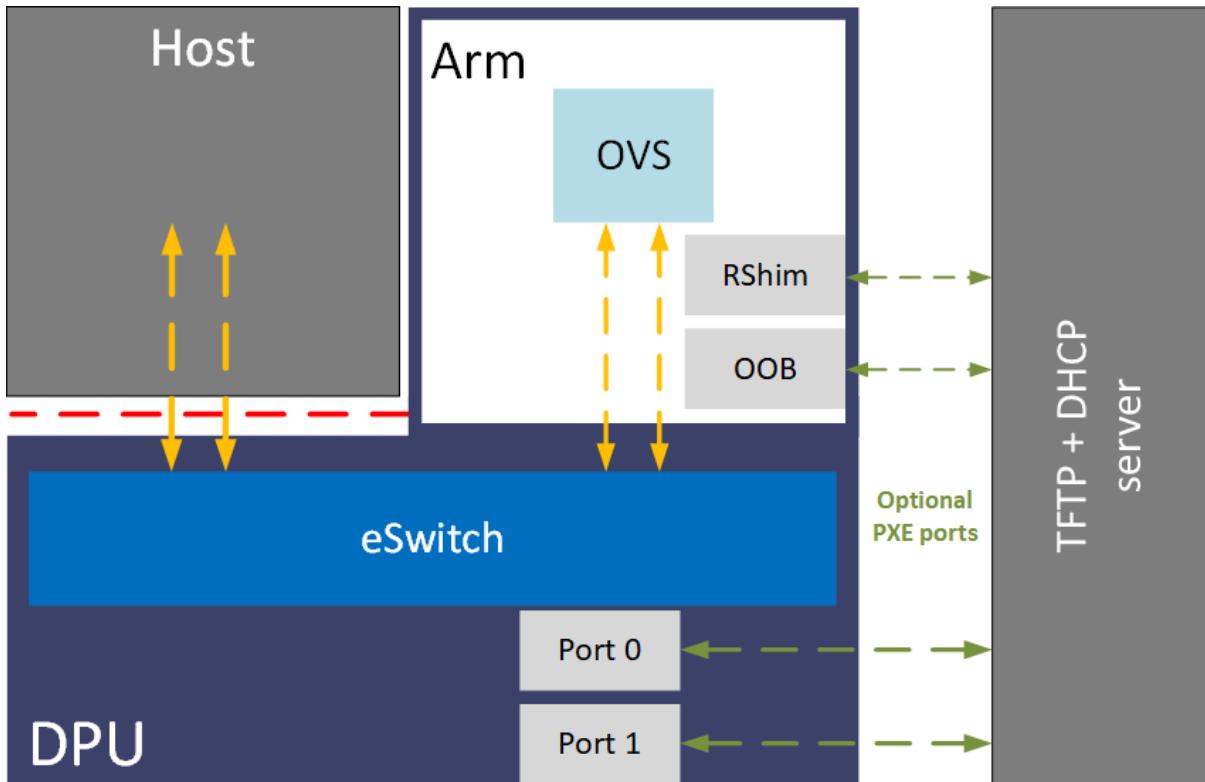
#### 4. Define DHCP.

```
/etc/dhcp/dhcpd.conf  
  
allow booting;  
allow bootp;  
  
subnet 192.168.100.0 netmask 255.255.255.0 {  
    range 192.168.100.10 192.168.100.20;  
    option broadcast-address 192.168.100.255;  
    option routers 192.168.100.1;  
    option domain-name-servers <ip-address-list>  
    option domain-search <domain-name-list>;  
    next-server 192.168.100.1;  
    filename "/BOOTAA64.EFI";  
}  
  
# Specify the IP address for this client.  
host tmfifo_pxe_client {  
    hardware ethernet 00:1a:ca:ff:ff:01;
```

```

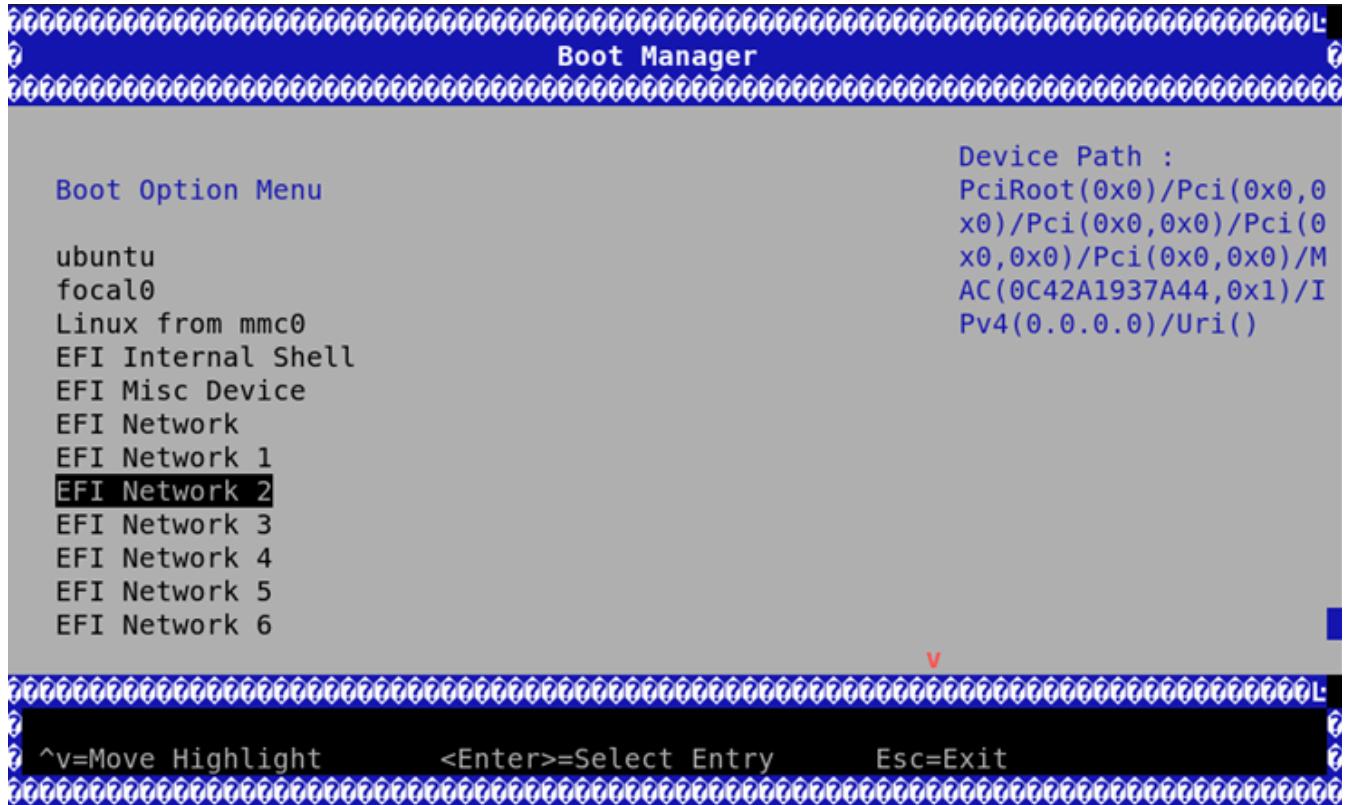
fixed-address 192.168.100.2;
}
subnet 20.7.0.0 netmask 255.255.0.0 {
    range 20.7.8.10 20.7.254.254;
    next-server 20.7.6.6;
    filename "/BOOTAA64.EFI";
}

```



## PXE Sequence

1. Connect to the BlueField console via UART or RShim console.
2. Reboot Arm.
3. Interrupt the boot process into UEFI menu.
4. Access the Boot Manager menu.
5. Select the relevant port to PXE from.



## PXE Sequence with Redfish

ISO upgrade via Redfish to set UEFI HTTPs/PXE boot by setting UEFI first boot source. To set the UEFI first boot source using Redfish:

1. Follow the instructions under section "[PXE Server Preparations](#)".
2. Check the current boot override settings by doing a GET on the ComputerSystem schema over 1GbE to the DPU's BMC. Look for the "Boot" property.

```
curl -k -X GET -u root:<password> https://<DPU-BMC-  
IP>/redfish/v1/Systems/<SystemID>/ | python3 -m json.tool  
{  
...  
"Boot": {  
"BootNext": "",  
"BootOrderPropertySelection": "BootOrder",  
"BootSourceOverrideEnabled": "Disabled",  
"BootSourceOverrideMode": "UEFI",  
"BootSourceOverrideTarget": "None",
```

```

    "UefiTargetBootSourceOverride": "None",
    ....
},
.....
"BootSourceOverrideEnabled@Redfish.AllowableValues": [
    "Once",
    "Continuous",
    "Disabled"
],
"BootSourceOverrideTarget@Redfish.AllowableValues": [
    "None",
    "Pxe",
    "UefiHttp",
    "UefiShell",
    "UefiTarget",
    "UefiBootNext"
],
.....
}

```

Boot override enables overriding the first boot source, either once or continuously.

3. The sample output above shows the BootSourceOverrideEnabled property is Disabled and BootSourceOverrideTarget is None. The BootSourceOverrideMode property should always be set to UEFI. Allowable values of BootSourceOverrideEnabled and BootSourceOverrideTarget are defined in the metadata (BootSourceOverrideEnabled@Redfish.AllowableValues and BootSourceOverrideTarget@Redfish.AllowableValues respectively).
4. If BootSourceOverrideEnabled is set to Once, after the first boot, boot override is disabled, and any related properties are reset to their former values to avoid repetition. If it is set to Continuous, then on every reboot the DPU keeps performing boot override (HTTPBoot).
5. To perform boot override, perform a PATCH to pending settings URI over 1GbE to the DPU's BMC.

```
curl -k -X PATCH -d '{"Boot": {"BootSourceOverrideEnabled": "Once",  
"BootSourceOverrideMode": "UEFI", "BootSourceOverrideTarget": "UefiHttp",  
"HttpBootUri": "http://<HTTP-Server-IP>/Image.iso"} }' -u root:<password>  
https://<DPU-BMC-IP>/redfish/v1/Systems/<SystemID>/Settings | python3 -m  
json.tool
```

For example:

```
curl -k -X GET -u root:<password> https://<DPU-BMC-  
IP>/redfish/v1/Systems/<SystemID>/ | python3 -m json.tool  
{  
...  
"Boot": {  
"BootNext": "",  
"BootOrderPropertySelection": "BootOrder",  
"BootSourceOverrideEnabled": "Once",  
"BootSourceOverrideMode": "UEFI",  
"BootSourceOverrideTarget": "UefiHttp",  
"UefiTargetBootSourceOverride": "None",  
.....  
},  
....  
}
```

6. After performing the above PATCH successfully, reboot the DPU using Redfish Manager schema over 1GbE to the DPU's BMC:

```
curl -k -u root:<password> -H "Content-Type: application/json" -X POST  
https://<DPU-BMC-  
IP>/redfish/v1/Systems/Bluefield/Actions/ComputerSystem.Reset -d  
'{"ResetType": "GracefulRestart"}'
```

7. Once UEFI has completed, check whether the settings are applied by performing a GET on ComputerSystem schema over 1GbE OOB to the DPU BMC.

 **Note**

The `HttpBootUri` property is parsed by the Redfish server and the URI is presented to the DPU as part of DHCP lease when the DPU performs the HTTP boot.

# Deploying NVIDIA Converged Accelerator

 **Info**

It is recommended to upgrade your BlueField product to the latest software and firmware versions available to benefit from new features and latest bug fixes.

This section assumes that you have installed the BlueField OS BFB on your NVIDIA® Converged Accelerator using any of the following guides:

- [Deploying DPU OS Using BFB from Host](#)
- [Deploying BlueField Software Using BFB from BMC](#)
- [Deploying BlueField Software Using BFB with PXE](#)

NVIDIA® CUDA® (GPU driver) must be installed in order to use the GPU. For information on how to install CUDA on your Converged Accelerator, refer to [NVIDIA CUDA Installation Guide for Linux](#).

## Configuring Operation Mode

After installing the BFB, you may now select the mode you want your NVIDIA Converged Accelerator to operate in.

- Standard (default) – the NVIDIA® BlueField® DPU and the GPU operate separately (GPU is owned by the host)
- BlueField-X – the GPU is exposed to the DPU and is no longer visible on the host (GPU is owned by the DPU)

### Note

It is important to know your device name (e.g., mt41686\_pciconf0).

MST tool is necessary for this purpose which is installed by default on the DPU.

Run:

```
mst status -v
```

Example output:

MST modules:

-----

MST PCI module is not loaded

MST PCI configuration module loaded

PCI devices:

-----

DEVICE\_TYPE MST PCI RDMA NET NUMA

BlueField2(rev:1) /dev/mst/mt41686\_pciconf0.1 3b:00.1 mlx5\_1

net-ens1f1 0

BlueField2(rev:1) /dev/mst/mt41686\_pciconf0 3b:00.0 mlx5\_0

net-ens1f0 0

## BlueField-X Mode

1. Run the following command from the host:

```
mlxconfig -d /dev/mst/<device-name> s  
PCI_DOWNSTREAM_PORT_OWNER[4]=0xF
```

2. Perform a [BlueField system-level reset](#) for the mlxconfig settings to take effect.

## Standard Mode

To return the DPU from BlueField-X mode to Standard mode:

1. Run the following command from the host:

```
mlxconfig -d /dev/mst/<device-name> s  
PCI_DOWNSTREAM_PORT_OWNER[4]=0x0
```

2. Perform a [BlueField system-level reset](#) for the mlxconfig settings to take effect.

## Verifying Configured Operational Mode

Use the following command from the host or BlueField:

```
$ sudo mlxconfig -d /dev/mst/<device-name> q  
PCI_DOWNSTREAM_PORT_OWNER[4]
```

- Example of Standard mode output:

```
Device #1:  
-----
```

[...]

Configurations: Next Boot

PCI\_DOWNSTREAM\_PORT\_OWNER[4] DEVICE\_DEFAULT(0)

- Example of BlueField-X mode output:

Device #1:

-----

[...]

Configurations: Next Boot

PCI\_DOWNSTREAM\_PORT\_OWNER[4] EMBEDDED\_CPU(15)

## Verifying GPU Ownership

The following are example outputs for when the DPU is configured to BlueField-X mode.

The GPU is no longer visible from the host:

```
root@host:~# lspci | grep -i nv
```

```
None
```

The GPU is now visible from the DPU:

```
ubuntu@dpu:~$ lspci | grep -i nv
```

```
06:00.0 3D controller: NVIDIA Corporation GA20B8 (rev a1)
```

## GPU Firmware

### Get GPU Firmware

smbpbi: (See SMBPBI spec)

```
root@dpu:~# i2cset -y 3 0x4f 0x5c 0x05 0x08 0x00 0x80 s
root@dpu:~# i2cget -y 3 0x4f 0x5c ip 5
5: 0x04 0x05 0x08 0x00 0x5f
root@dpu:~# i2cget -y 3 0x4f 0x5d ip 5
5: 0x04 0x39 0x32 0x2e 0x30
root@dpu:~#
root@dpu:~#
root@dpu:~# i2cset -y 3 0x4f 0x5c 0x05 0x08 0x01 0x80 s
root@dpu:~# i2cget -y 3 0x4f 0x5c ip 5
5: 0x04 0x05 0x08 0x01 0x5f
root@dpu:~# i2cget -y 3 0x4f 0x5d ip 5
5: 0x04 0x30 0x2e 0x36 0x42
root@dpu:~# i2cset -y 3 0x4f 0x5c 0x05 0x08 0x02 0x80 s
root@dpu:~# i2cget -y 3 0x4f 0x5c ip 5
5: 0x04 0x05 0x08 0x02 0x5f
root@dpu:~# i2cget -y 3 0x4f 0x5d ip 5
5: 0x04 0x2e 0x30 0x30 0x2e
root@dpu:~# i2cset -y 3 0x4f 0x5c 0x05 0x08 0x03 0x80 s
root@dpu:~# i2cget -y 3 0x4f 0x5c ip 5
5: 0x04 0x05 0x08 0x03 0x5f
root@dpu:~# i2cget -y 3 0x4f 0x5d ip 5
5: 0x04 0x30 0x31 0x00 0x00
root@dpu:~#
```

39 32 2e 30 30 2e 36 42 2e 30 30 2e 30 31 00 00 92.00.6B.00.01

## Updating GPU Firmware

```
root@dpu:~# scp root@10.23.201.227:<path-to-fw-
bin>/1004_0230_891_92006B0001-dbg-ota.bin /tmp/gpu_images/
root@10.23.201.227's password:
1004_0230_891_92006B0001-dbg-ota.bin 100% 384KB 384.4KB/s 00:01
```

```
root@dpu:~# cat /tmp/gpu_images/progress.txt
```

```
TaskState="Running"
TaskStatus="OK"
TaskProgress="50"

root@dpu:~# cat /tmp/gpu_images/progress.txt
TaskState="Running"
TaskStatus="OK"
TaskProgress="50"

root@dpu:~# cat /tmp/gpu_images/progress.txt
TaskState=Firmware update succeeded.
TaskStatus=OK
TaskProgress=100
```

## Installing Repo Package on Host Side

### Note

This section assumes that a BlueField DPU has already been installed in a server according to the instructions detailed in the [DPU's hardware user guide](#).

The following procedure instructs users on upgrading DOCA local repo package for host.

## Removing Previously Installed DOCA Runtime Packages

If an older DOCA software version is installed on your host, make sure to uninstall it before proceeding with the installation of the new version:

Ubuntu	host# for f in \$( dpkg --list   grep doca   awk '{print \$2}' ); do echo \$f ; apt remove --purge \$f -y ; done
--------	--

	host# sudo apt-get autoremove
CentOS/R HEL	<pre>host# for f in \$(rpm -qa  grep -i doca ) ; do yum -y remove \$f; done host# yum autoremove host# yum makecache</pre>

## Downloading DOCA Runtime Packages

The following table provides links to DOCA Runtime packages depending on the OS running on your host.

OS	Arch	Link
Alinux 3.2	x86	<a href="#">doca-host-2.7.0-204000_24.04_alinux32.x86_64.rpm</a>
Anolis	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_anolis86.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_anolis86.x86_64.rpm</a>
BCLinux 21.10 SP2	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_bclinux2110sp2.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_bclinux2110sp2.x86_64.rpm</a>
CTyunOS 2.0	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_ctyunos20.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_ctyunos20.x86_64.rpm</a>
CTyunOS 23.01	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_ctyunos2301.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_ctyunos2301.x86_64.rpm</a>
Debian 10.13	aarch64	<a href="#">doca-host_2.7.0-204000-24.04-debian1013_arm64.deb</a>
	x86	<a href="#">doca-host_2.7.0-204000-24.04-debian1013_amd64.deb</a>
Debian 10.8	aarch64	<a href="#">doca-host_2.7.0-204000-24.04-debian108_arm64.deb</a>
	x86	<a href="#">doca-host_2.7.0-204000-24.04-debian108_amd64.deb</a>

OS	Arch	Link
Debian 10.9	x86	<a href="#">doca-host_2.7.0-204000-24.04-debian109_amd64.deb</a>
Debian 11.3	aarch64	<a href="#">doca-host_2.7.0-204000-24.04-debian113_arm64.deb</a>
	x86	<a href="#">doca-host_2.7.0-204000-24.04-debian113_amd64.deb</a>
Debian 12.1	aarch64	<a href="#">doca-host_2.7.0-204000-24.04-debian121_arm64.deb</a>
	x86	<a href="#">doca-host_2.7.0-204000-24.04-debian121_amd64.deb</a>
EulerOS 20 SP11	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_euleros20sp11.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_euleros20sp11.x86_64.rpm</a>
EulerOS 20 SP12	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_euleros20sp12.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_euleros20sp12.x86_64.rpm</a>
Fedora32	x86	<a href="#">doca-host-2.7.0-204000_24.04_fc32.x86_64.rpm</a>
Kylin 1.0 SP2	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_kylin10sp2.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_kylin10sp2.x86_64.rpm</a>
Kylin 1.0 SP3	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_kylin10sp3.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_kylin10sp3.x86_64.rpm</a>
Mariner 2.0	x86	<a href="#">doca-host-2.7.0-204000_24.04_mariner20.x86_64.rpm</a>
Oracle Linux 7.9	x86	<a href="#">doca-host-2.7.0-204000_24.04_ol79.x86_64.rpm</a>
Oracle Linux 8.4	x86	<a href="#">doca-host-2.7.0-204000_24.04_ol84.x86_64.rpm</a>
Oracle Linux 8.6	x86	<a href="#">doca-host-2.7.0-204000_24.04_ol86.x86_64.rpm</a>
Oracle Linux 8.7	x86	<a href="#">doca-host-2.7.0-204000_24.04_ol87.x86_64.rpm</a>
Oracle Linux 8.8	x86	<a href="#">doca-host-2.7.0-204000_24.04_ol88.x86_64.rpm</a>
Oracle Linux 9.0	x86	<a href="#">doca-host-2.7.0-204000_24.04_ol90.x86_64.rpm</a>
Oracle Linux 9.1	x86	<a href="#">doca-host-2.7.0-204000_24.04_ol91.x86_64.rpm</a>

OS	Arch	Link
Oracle Linux 9.2	x86	<a href="#">doca-host-2.7.0-204000_24.04_ol92.x86_64.rpm</a>
openEuler 20.03 SP3	aarch6	<a href="#">doca-host-2.7.0-204000_24.04_openeuler2003sp3.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_openeuler2003sp3.x86_64.rpm</a>
openEuler 22.03	aarch6	<a href="#">doca-host-2.7.0-204000_24.04_openeuler2203.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_openeuler2203.x86_64.rpm</a>
RHEL/CentOS 8.0	aarch6	<a href="#">doca-host-2.7.0-204000_24.04_rhel80.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel80.x86_64.rpm</a>
RHEL/CentOS 8.1	aarch6	<a href="#">doca-host-2.7.0-204000_24.04_rhel81.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel81.x86_64.rpm</a>
RHEL/CentOS 8.2	aarch6	<a href="#">doca-host-2.7.0-204000_24.04_rhel82.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel82.x86_64.rpm</a>
RHEL/CentOS 8.3	aarch6	<a href="#">doca-host-2.7.0-204000_24.04_rhel83.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel83.x86_64.rpm</a>
RHEL/CentOS 8.4	aarch6	<a href="#">doca-host-2.7.0-204000_24.04_rhel84.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel84.x86_64.rpm</a>
RHEL/CentOS 8.5	aarch6	<a href="#">doca-host-2.7.0-204000_24.04_rhel85.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel85.x86_64.rpm</a>
RHEL/Rocky 8.6	aarch6	<a href="#">doca-host-2.7.0-204000_24.04_rhel86.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel86.x86_64.rpm</a>

OS	Arch	Link
RHEL/Rocky 8.7	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_rhel87.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel87.x86_64.rpm</a>
RHEL/Rocky 8.8	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_rhel88.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel88.x86_64.rpm</a>
RHEL/Rocky 8.9	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_rhel89.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel89.x86_64.rpm</a>
RHEL/Rocky 8.10	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_rhel810.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel810.x86_64.rpm</a>
RHEL/Rocky 9.0	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_rhel90.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel90.x86_64.rpm</a>
RHEL/Rocky 9.1	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_rhel91.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel91.x86_64.rpm</a>
RHEL/Rocky 9.2	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_rhel92.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel92.x86_64.rpm</a>
RHEL/Rocky 9.3	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_rhel93.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel93.x86_64.rpm</a>
RHEL/Rocky 9.4	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_rhel94.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_rhel94.x86_64.rpm</a>
SLES 15 SP2	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_sles15sp2.aarch64.rpm</a>

OS	Arch	Link
	x86	<a href="#">doca-host-2.7.0-204000_24.04_sles15sp2.x86_64.rpm</a>
SLES 15 SP3	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_sles15sp3.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_sles15sp3.x86_64.rpm</a>
SLES 15 SP4	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_sles15sp4.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_sles15sp4.x86_64.rpm</a>
SLES 15 SP5	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_sles15sp5.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_sles15sp5.x86_64.rpm</a>
SLES 15 SP6	x86	<a href="#">doca-host-2.7.0-204000_24.04_sles15sp6.x86_64.rpm</a>
TencentOS 3.3	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_tencentos33.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_tencentos33.x86_64.rpm</a>
Ubuntu 20.04	aarch64	<a href="#">doca-host_2.7.0-204000-24.04-ubuntu2004_arm64.deb</a>
	x86	<a href="#">doca-host_2.7.0-204000-24.04-ubuntu2004_amd64.deb</a>
Ubuntu 22.04	aarch64	<a href="#">doca-host_2.7.0-204000-24.04-ubuntu2204_arm64.deb</a>
	x86	<a href="#">doca-host_2.7.0-204000-24.04-ubuntu2204_amd64.deb</a>
Ubuntu 24.04	aarch64	<a href="#">doca-host_2.7.0-204000-24.04-ubuntu2404_arm64.deb</a>
	x86	<a href="#">doca-host_2.7.0-204000-24.04-ubuntu2404_amd64.deb</a>
UOS20.1060	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_uos201060.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_uos201060.x86_64.rpm</a>
UOS20.1060A	aarch64	<a href="#">doca-host-2.7.0-204000_24.04_uos201060a.aarch64.rpm</a>
	x86	<a href="#">doca-host-2.7.0-204000_24.04_uos201060a.x86_64.rpm</a>

OS	Arch	Link
XenServer 8.2	x86	<a href="#">doca-host-2.7.0-204000_24.04_xenserver82.x86_64.rpm</a>

## Installing Local Repo Package for Host Dependencies

1. Install DOCA local repo package for host:

OS	Procedure
Ubuntu	<ol style="list-style-type: none"> <li>1. Download the DOCA SDK and DOCA Runtime packages from <a href="#">Downloading DOCA Runtime Packages</a> section for the host.</li> <li>2. Unpack the deb repo. Run:           <pre>host# sudo dpkg -i doca-host-repo-ubuntu&lt;version&gt;.amd64.deb</pre> </li> <li>3. Perform apt update. Run:           <pre>host# sudo apt-get update</pre> </li> <li>4. Run apt install for DOCA runtime, tools, and SDK:           <pre>host# sudo apt install -y doca-runtime doca-sdk</pre> </li> </ol>
Cent OS	<ol style="list-style-type: none"> <li>1. Download the DOCA SDK and DOCA Runtime packages from <a href="#">Downloading DOCA Runtime Packages</a> section for the x86 host.</li> <li>2. Install the following software dependencies. Run:           <pre>host# sudo yum install -y epel-release</pre> </li> <li>3. For CentOS 8.2 only, also run:           <pre>host# yum config-manager --set-enabled PowerTools</pre> </li> <li>4. Unpack the RPM repo. Run:           <pre>host# sudo rpm -Uvh doca-host-repo-rhel&lt;version&gt;.x86_64.rpm</pre> </li> <li>5. Run yum install for DOCA runtime, tools, and SDK.           <pre>host# sudo yum install -y doca-runtime doca-sdk</pre> </li> </ol>
RHEL	<ol style="list-style-type: none"> <li>1. Open a RedHat account.           <ol style="list-style-type: none"> <li>1. Log into RedHat website via the <a href="#">developers</a> tab.</li> <li>2. <a href="#">Create a developer user</a>.</li> </ol> </li> <li>2. Run:</li> </ol>

OS	Procedure
	<pre>host# subscription-manager register --username=&lt;username&gt; -- password=PASSWORD</pre> <p>To extract pool ID:</p> <pre>host# subscription-manager list --available --all ... Subscription Name: Red Hat Developer Subscription <a href="#">for</a> Individuals Provides: Red Hat Developer Tools (<a href="#">for</a> RHEL Server <a href="#">for</a> ARM) ... Red Hat CodeReady Linux Builder <a href="#">for</a> x86_64 ... Pool ID: &lt;pool-id&gt; ...</pre> <p>And use the pool ID for the Subscription Name and Provides that include Red Hat CodeReady Linux Builder for x86_64.</p> <p>3. Run:</p> <pre>host# subscription-manager attach --pool=&lt;pool-id&gt; host# subscription-manager repos --enable codeready-builder- <a href="#">for</a>-rhel-8-x86_64-rpms host# yum makecache</pre> <p>4. Install the DOCA local repo package for host. Run:</p> <pre>host# rpm -Uvh doca-host-repo-rhel&lt;version&gt;.x86_64.rpm host# sudo yum install -y doca-runtime doca-sdk</pre> <p>5. Sign out from your RHEL account. Run:</p> <pre>host# subscription-manager remove --all host# subscription-manager unregister</pre>

2. Assign a dynamic IP to tmfifo\_net0 interface (RShim host interface).

```
host# ifconfig tmfifo_net0 192.168.100.1 netmask 255.255.255.252 up
```

3. Verify that RShim is active.

```
host# sudo systemctl status rshim
```

This command is expected to display "active (running)". If RShim service does not launch automatically, run:

```
host# sudo systemctl enable rshim  
host# sudo systemctl start rshim
```

## Installing Popular Linux Distributions on BlueField

### Building Your Own BFB Installation Image

Users wishing to build their own customized NVIDIA® BlueField® OS image can use the BFB build environment. See [this GitHub webpage](#) for more information.

#### Note

For any customized BlueField OS image to boot on the UEFI secure-boot-enabled DPU (default DPU secure boot setting), the OS must be either signed with an existing key in the UEFI DB (e.g., the Microsoft key), or UEFI secure boot must be disabled. See "[Secure Boot](#)" and its subpages for more details.

### Installing Linux Distributions

Contact [NVIDIA Enterprise Support](#) for information on the installation of Linux distributions other than Ubuntu.

# BlueField Linux Drivers

The following table lists the BlueField drivers which are part of the Official Ubuntu Linux distribution for BlueField. Some of the drivers are not in the upstream Linux kernel yet.

Driver	Description	BlueField-2	BlueField-3
bluefi_eld-edac	BlueField-specific EDAC driver		
dw_mc_bluefield	BlueField DW Multimedia Card driver		
sdhci-of-dwcmshc	SDHCI platform driver for Synopsys DWC MSHC		
gpio-mlxbf2	GPIO driver		
gpio-mlxbf3	GPIO driver		
i2c-mlx	I2C bus driver (i2c-mlxbf.c upstream)		
ipmb-dev-int	Driver needed to receive IPMB messages from a BMC and send a response back. This driver works with the I2C driver and a user-space program such as OpenIPMI.		
ipmb-host	Driver needed on the DPU to send IPMB messages to the BMC on the IPMB bus. This driver works with the I2C driver. It only loads successfully if it executes a successful handshake with the BMC.		
mlxbf-gige	Gigabit Ethernet driver		
mlxbf-livefis	BlueField HCA firmware burning driver. This driver supports burning firmware for the embedded HCA in the BlueField SoC.		

Driver	Description	BlueField-2	BlueField-3
mlxbfpka	BlueField PKA kernel module		
mlxbf-pmc	Performance monitoring counters. The driver provides access to available performance modules through the sysfs interface. The performance modules in BlueField are present in several hardware blocks and each block has a certain set of supported events.		
mlxbf-ptm	Kernel driver that provides a debugfs interface for the system software to monitor the BlueField device's power and thermal management parameters.		
mlxbftmfifo	TMFIFO driver for BlueField SoC		
mlx-bootctl	Boot control driver. This driver provides a sysfs interface for systems management software to manage reset time actions.		
mlx-trio	TRIO driver for BlueField SoC		
pwr-mlxbf	Supports reset or low-power mode handling for BlueField.		
pinctrl-mlxbf	Allows multiplexing individual GPIOs to switch from the default hardware mode to software-controlled mode.		
mlxbf-pmc	Mellanox PMC driver		

## Updating DPU Software Packages Using Standard Linux Tools

This dpu-upgrade procedure enables upgrading DOCA components using standard Linux tools (e.g., apt update and yum update). This process utilizes native package manager repositories to upgrade DPUs without the need for a full installation, and has the following benefits :

- Only updates components that include modifications
  - Configurable – user can select specific components (e.g., UEFI-ATF, NIC-FW)
- Includes upgrade of:
  - DOCA drivers and libraries
  - DOCA reference applications
  - BSP (UEFI/ATF) upgrade while maintaining the configuration
  - NIC firmware upgrade while maintaining the configuration
- Does not:
  - Impact user binaries
  - Upgrade non-Ubuntu OS kernels
  - Upgrade DPU BMC firmware
- After completion of DPU upgrade:
  - If NIC firmware was not updated, perform DPU Arm reset (software reset / reboot DPU)
  - If NIC firmware was updated, perform firmware reset (mlxfwreset) or perform a graceful shutdown and power cycle

OS	Action	Instructions
Ubuntu/ Debian	Remove mlxbf- bootimages package	<pre>&lt;dpu&gt; \$ apt remove --purge mlxbf-bootimages* -y</pre>
	Install the the GPG key	<pre>&lt;dpu&gt; \$ apt update &lt;dpu&gt; \$ apt install gnupg2</pre>
	Export the desired	Export DOCA_REPO with the relevant URL. The following is an example for Ubuntu 22.04:

OS	Action	Instructions
	distribution	<pre>&lt;dpu&gt; \$ export DOCA_REPO="https://linux.mellanox.com/public/repo/doca/ 2.7.0/ubuntu22.04/dpu-arm64"</pre> <ul style="list-style-type: none"> <li>Ubuntu 22.04 – <a href="https://linux.mellanox.com/public/repo/doca/2.7.0/ubuntu22.04/dpu-arm64">https://linux.mellanox.com/public/repo/doca/2.7.0/ubuntu22.04/dpu-arm64</a></li> <li>Ubuntu 20.04 – <a href="https://linux.mellanox.com/public/repo/doca/2.7.0/ubuntu20.04/dpu-arm64">https://linux.mellanox.com/public/repo/doca/2.7.0/ubuntu20.04/dpu-arm64</a></li> <li>Debian 12 – <a href="https://linux.mellanox.com/public/repo/doca/2.7.0/debian12/dpu-arm64">https://linux.mellanox.com/public/repo/doca/2.7.0/debian12/dpu-arm64</a></li> </ul>
	Add GPG key to APT trusted keyring	<pre>&lt;dpu&gt; \$ curl \$DOCA_REPO/GPG-KEY-Mellanox.pub   gpg -- dearmor &gt; /etc/apt/trusted.gpg.d/GPG-KEY-Mellanox.pub</pre>
	Add DOCA online repository	<pre>&lt;dpu&gt; \$ echo "deb [signed-by=/etc/apt/trusted.gpg.d/GPG- KEY-Mellanox.pub] \$DOCA_REPO ./" &gt; /etc/apt/sources.list.d/doxa.list</pre>
	Update index	<pre>&lt;dpu&gt; \$ apt update</pre>
	Upgrade UEFI/ATF firmware	<p>Run:</p> <pre>&lt;dpu&gt; \$ apt install mlxbf-bootimages-signed</pre> <p>Then initiate upgrade for UEFI/ATF firmware:</p> <pre>&lt;dpu&gt; \$ apt install mlxbf-scripts &lt;dpu&gt; \$ bfrec</pre>
	Upgrade BlueField DPU NIC firmware	<p>Run:</p> <pre>&lt;dpu&gt; \$ apt install mlnx-fw-updater-signed.aarch64</pre>

OS	Action	Instructions
		<p><b>(i) Note</b> This immediately starts NIC firmware upgrade.</p> <p>To prevent automatic upgrade, run:</p> <pre>&lt;dpu&gt; \$ export RUN_FW_UPDATER=no</pre>
	Remove old metapackages	<pre>&lt;dpu&gt; \$ apt-get remove doca-tools doca-sdk doca-runtime -y</pre>
	Install new metapackages	<pre>&lt;dpu&gt; \$ apt-get install doca-runtime doca-devel -y</pre>
	Upgrade system	<pre>&lt;dpu&gt; \$ apt upgrade</pre>
	Apply the new changes, NIC firmware, and UEFI/ATF	<p>For the upgrade to take effect, perform BlueField system reboot as explained in the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page.</p> <p><b>(i) Note</b> This step triggers immediate reboot of the BlueField Arm cores.</p>
Cent OS/RHEL/Anolis/Rocky	Remove mlxbf-bootimages package  Export the desired distribution	<pre>&lt;dpu&gt; \$ yum -y remove mlxbf-bootimages*</pre> <pre>&lt;dpu&gt; \$ yum makecache</pre> <p>Export DOCA_REPO with the relevant URL. The following is an example for Rocky Linux 8.6:</p> <pre>&lt;dpu&gt; \$ export DOCA_REPO="https://linux.mellanox.com/public/repo/doca/</pre>

OS	Action	Instructions
		<pre>2.7.0/rhel8.6/dpu-arm64/"</pre> <ul style="list-style-type: none"> <li>• AnolisOS 8.6 – <a href="https://linux.mellanox.com/public/repo/doxa/2.7.0/anolis8.6/dpu-arm64/">https://linux.mellanox.com/public/repo/doxa/2.7.0/anolis8.6/dpu-arm64/</a></li> <li>• OpenEuler 20.03 sp1 – <a href="https://linux.mellanox.com/public/repo/doxa/2.7.0/openeuler20.03sp1/dpu-arm64/">https://linux.mellanox.com/public/repo/doxa/2.7.0/openeuler20.03sp1/dpu-arm64/</a></li> <li>• CentOS 7.6 with 4.19 kernel – <a href="https://linux.mellanox.com/public/repo/doxa/2.7.0/rhel7.6-4.19/dpu-arm64/">https://linux.mellanox.com/public/repo/doxa/2.7.0/rhel7.6-4.19/dpu-arm64/</a></li> <li>• CentOS 7.6 with 5.10 kernel – <a href="https://linux.mellanox.com/public/repo/doxa/2.7.0/rhel7.6-5.10/dpu-arm64/">https://linux.mellanox.com/public/repo/doxa/2.7.0/rhel7.6-5.10/dpu-arm64/</a></li> <li>• CentOS 7.6 with 5.4 kernel – <a href="https://linux.mellanox.com/public/repo/doxa/2.7.0/rhel7.6/dpu-arm64/">https://linux.mellanox.com/public/repo/doxa/2.7.0/rhel7.6/dpu-arm64/</a></li> <li>• Rocky Linux 8.6 – <a href="https://linux.mellanox.com/public/repo/doxa/2.7.0/rhel8.6/dpu-arm64/">https://linux.mellanox.com/public/repo/doxa/2.7.0/rhel8.6/dpu-arm64/</a></li> </ul>
	Add DOCA online repository	<pre>echo "[doxa] name=DOCA Online Repo baseurl=\$DOCA_REPO enabled=1 gpgcheck=0 priority=10 cost=10" &gt; /etc/yum.repos.d/doxa.repo</pre> <p>A file is created under /etc/yum.repos.d/doxa.repo .</p>
	Update index	<pre>&lt;dpu&gt; \$ yum makecache</pre>
	Upgrade UEFI/ATF firmware	<p>Run:</p> <pre>&lt;dpu&gt; \$ yum install mlxbf-bootimages-signed.aarch64 mlxbf-bfscripts</pre>

OS	Action	Instructions
		<p>Then I initiate the upgrade for UEFI/ATF firmware:</p> <pre>&lt;dpu&gt; \$ bfrec</pre>
Upgrade BlueField DPU NIC firmware		<p>The following command updates the firmware package and automatically attempts to flash the firmware to the NIC:</p> <pre>&lt;dpu&gt; \$ yum install mlxnx-fw-updater-signed.aarch64</pre>
		<p><b>i Info</b> This step can be used as a standalone firmware update. In any case, it is performed as part of the upgrade flow.</p>
		<p><b>i Note</b> To prevent automatic flashing of the firmware to the NIC, run the following first:</p> <pre>&lt;dpu&gt; \$ export RUN_FW_UPDATER=no</pre> <p>0000018f-6041-db75-a1af-f9cb40730003</p>
Remove old metapackages		<pre>&lt;dpu&gt; \$ yum -y remove doca-tools doca-sdk doca-runtime</pre>
Install new metapackages		<pre>&lt;dpu&gt; \$ yum -y install doca-runtime doca-devel</pre>
Upgrade system		<pre>&lt;dpu&gt; \$ yum upgrade --nobest</pre>
Apply the new changes,		<p>For the upgrade to take effect, perform BlueField system reboot as explained in the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page.</p>

OS	Action	Instructions
	NIC firmware, and UEFI/ATF	<p> <b>Note</b> This step triggers immediate reboot of the BlueField Arm cores.</p>

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# Management

- [Performance Monitoring Counters](#)
- [Intelligent Platform Management Interface](#)
- [Redfish](#)
- [Logging](#)
- [SoC Management Interface](#)
- [BlueField OOB Ethernet Interface](#)

## Performance Monitoring Counters

The performance modules in NVIDIA® BlueField® are present in several hardware blocks and each block has a certain set of supported events.

The mlx\_pmc driver provides access to all of these performance modules through a sysfs interface. The driver creates a directory under /sys/class/hwmon under which each of the blocks explained above has a subdirectory. Please note that all directories under /sys/class/hwmon are named as "hwmon<N>" where N is the hwmon device number corresponding to the device. This is assigned by Linux and could change with the addition of more devices to the hwmon class. Each hwmon directory has a "name" node which can be used to identify the correct device. In this case, reading the "name" file should return "bfperf".

The hardware blocks that include performance modules are:

- Tile (block containing 2 cores and a shared L2 cache) has 2 sets of counters, one set for HNF and HNF\_NET events. These are present as "tile" and "tilenet" directories in the sysfs interface of the driver.
- TRIO (PCIe root complex) has 3 sets of counters, one each for TRIO, SMGEN and PCIE TLR events. The sysfs directories for these are called "trio", "triongen" and "pcie"

respectively.

- MSS (memory sub-system containing the memory controller and L3 cache)
- GIC and SMMU with one set of counters each for the SMGEN events. These are simply labelled "gic" and "smmu" respectively.

The number of Tile, TRIO and MSS blocks depends on the system. There is a maximum of 8 Tile, 3 TRIO and 2 MSS blocks in BlueField, and this is added as a suffix to the sysfs directory names. For example, this is a list of directories present in a BlueField-2 system:

```
ubuntu@dpu:/$ ls /sys/class/hwmon/hwmon0/
device l3cachehalf0 pcie0 smmu0 tile1 tilenet0 tilenet3 triogen0
ecc l3cachehalf1 pcie1 subsystem tile2 tilenet1 trio0 triogen1
gic0 name power tile0 tile3 tilenet2 trio1 uevent
```

The PCIe TLR statistics for each TRIO are under the "pcie" block.

## Performance Data Collection Mechanisms

The performance data of the BlueField hardware is collected using two mechanisms:

1. Programming hardware counters to monitor specific events
2. Reading registers that hold performance/event statistics

All blocks except "ecc" and "pcie" use the mechanism 1.

## Using Hardware Counters

For blocks that use hardware counters to collect data, each counter present in the block is represented by "event<N>" and "counter<N>" sysfs files.

For example:

```
ubuntu@dpu:/$ ls /sys/class/hwmon/hwmon0/tile0/
counter0 counter1 counter2 counter3 event0 event1 event2 event3 event_list
```

An event<N> and counter<N> pair can be used to program and monitor events. The "event\_list" sysfs file displays the list of events supported by that block along with the hexadecimal value corresponding to each event.

Use the echo command to write the event number to the event<N> file, and use the cat command to read the counter value from the corresponding counter (counter<N>).

The counters are enabled individually once the event number is written to the corresponding event file. However, the L3 cache performance counters cannot be enabled or disabled individually and can only be triggered or stopped all at the same time.

So in the example provided, all 4 event files may be programmed with the necessary event numbers and then the "enable" file may be used to start the counters. Writing 0 to the enable file stops the counters while 1 starts them.

## Reading Registers

For "ecc" and "pcie" blocks, the counters cannot be started or stopped by the user, instead the statistics are automatically collected by HW and stored in registers. These register names are exposed within the directory and can be read by the user at any time.

## List of Supported Events

### SMGEN Performance Module

Hex Value	Name	Description
0x0	AW_REQ	Reserved for internal use
0x1	AW_BEATS	Reserved for internal use
0x2	AW_TRANS	Reserved for internal use
0x3	AW_RESP	Reserved for internal use
0x4	AW_STL	Reserved for internal use
0x5	AW_LAT	Reserved for internal use

Hex Value	Name	Description
0x6	AW_REQ_TBU	Reserved for internal use
0x8	AR_REQ	Reserved for internal use
0x9	AR_BEATS	Reserved for internal use
0xa	AR_TRANS	Reserved for internal use
0xb	AR_STL	Reserved for internal use
0xc	AR_LAT	Reserved for internal use
0xd	AR_REQ_TBU	Reserved for internal use
0xe	TBU_MISS	The number of TBU miss
0xf	TX_DAT_AF	Mesh Data channel write FIFO almost Full. This is from the TRIO toward the Arm memory.
0x10	RX_DAT_AF	Mesh Data channel read FIFO almost Full. This is from the Arm memory toward the TRIO.
0x11	RETRYQ_CRED	Reserved for internal use

## Tile HNF Performance Module

Hex Value	Name	Description
0x45	HNF_REQUESTS	Number of REQS that were processed in HNF
0x46	HNF_REJECTS	Reserved for internal use
0x47	ALL_BUSY	Reserved for internal use
0x48	MAF_BUSY	Reserved for internal use
0x49	MAF_REQUESTS	Reserved for internal use
0x4a	RNF_REQUESTS	Number of REQS sent by the RN-F selected by HNF_PERF_CTL register RNF_SEL field
0x4b	REQUEST_TYP	Reserved for internal use

Hex Value	Name	Description
	E	
0x4c	MEMORY_READS	Number of reads to MSS
0x4d	MEMORY_Writes	Number of writes to MSS
0x4e	VICTIM_WRITE	Number of victim lines written to memory
0x4f	POC_FULL	Reserved for internal use
0x50	POC_FAIL	Number of times that the POC Monitor sent RespErr Okay status to an Exclusive WriteNoSnp or CleanUnique REQ
0x51	POC_SUCCESS	Number of times that the POC Monitor sent RespErr ExOkay status to an Exclusive WriteNoSnp or CleanUnique REQ
0x52	POC_WRITES	Number of Exclusive WriteNoSnp or CleanUnique REQs processed by POC Monitor
0x53	POC_READS	Number of Exclusive ReadClean/ReadShared REQs processed by POC Monitor
0x54	FORWARD	Reserved for internal use
0x55	RXREQ_HNF	Reserved for internal use
0x56	RXRSP_HNF	Reserved for internal use
0x57	RXDAT_HNF	Reserved for internal use
0x58	TXREQ_HNF	Reserved for internal use
0x59	TXRSP_HNF	Reserved for internal use
0x5a	TXDAT_HNF	Reserved for internal use
0x5b	TXSNP_HNF	Reserved for internal use
0x5c	INDEX_MATCH	Reserved for internal use
0x5d	A72_ACCESS	Access requests (Reads, Writes, CopyBack, CMO, DVM) from A72 clusters
0x5e	IO_ACCESS	Accesses requests (Reads, Writes) from DMA IO devices
0x5f	TSO_WRITE	Total Store Order write Requests from DMA IO devices

Hex Value	Name	Description
0x60	TSO_CONFLICT	Reserved for internal use
0x61	DIR_HIT	Requests that hit in directory
0x62	HNF_ACCEPTS	Reserved for internal use
0x63	REQ_BUF_EMPTY	Number of cycles when request buffer is empty
0x64	REQ_BUF_IDLE_MAF	Reserved for internal use
0x65	TSO_NOARB	Reserved for internal use
0x66	TSO_NOARB_CYCLES	Reserved for internal use
0x67	MSS_NO_CREDIT	Number of cycles that a Request could not be sent to MSS due to lack of credits
0x68	TXDAT_NO_LCRD	Reserved for internal use
0x69	TXSNP_NO_LCRD	Reserved for internal use
0x6a	TXRSP_NO_LCRD	Reserved for internal use
0x6b	TXREQ_NO_LCRD	Reserved for internal use
0x6c	TSO_CL_MATC_H	Reserved for internal use
0x6d	MEMORY_READS_BYPASS	Number of reads to MSS that bypass Home Node
0x6e	TSO_NOARB_TIMEOUT	Reserved for internal use
0x6f	ALLOCATE	Number of times that Directory entry was allocated
0x70	VICTIM	Number of times that Directory entry allocation did not find an Invalid way in the set

Hex Value	Name	Description
0x71	A72_WRITE	Write requests from A72 clusters
0x72	A72_Read	Read requests from A72 clusters
0x73	IO_WRITE	Write requests from DMA IO devices
0x74	IO_Reads	Read requests from DMA IO devices
0x75	TSO_Reject	Reserved for internal use
0x80	TXREQ_RN	Reserved for internal use
0x81	TXRSP_RN	Reserved for internal use
0x82	TXDAT_RN	Reserved for internal use
0x83	RXSNP_RN	Reserved for internal use
0x84	RXRSP_RN	Reserved for internal use
0x85	RXDAT_RN	Reserved for internal use

## TRIO Performance Module

Hex Value	Name	Description
0xa0	TPIO_DATA_BEAT	Data beats from Arm PIO to TRIO
0xa1	TDMA_DATA_BEAT	Data beats from Arm memory to PCI completion
0xa2	MAP_DATA_BEAT	Reserved for internal use
0xa3	TXMSG_DATA_BEAT	Reserved for internal use
0xa4	TPIO_DATA_PACKET	Data packets from Arm PIO to TRIO
0xa5	TDMA_DATA_PACKET	Data packets from Arm memory to PCI completion
0xa6	MAP_DATA_PACKET	Reserved for internal use
0xa7	TXMSG_DATA_PACKET	Reserved for internal use
0xa8	TDMA_RT_AF	The in-flight PCI DMA READ request queue is almost full

Hex Value	Name	Description
0xa9	TDMA_PBUF_MAC_AF	Indicator of the buffer of Arm memory reads is too full awaiting PCIe access
0xaa	TRIO_MAP_WRQ_BUF_EMPTY	PCIe write transaction buffer is empty
0xab	TRIO_MAP_CPL_BUF_EMPTY	Arm PIO request completion queue is empty
0xac	TRIO_MAP_RDQ0_BUF_EMPTY	The buffer of MAC0's read transaction is empty
0xad	TRIO_MAP_RDQ1_BUF_EMPTY	The buffer of MAC1's read transaction is empty
0xae	TRIO_MAP_RDQ2_BUF_EMPTY	The buffer of MAC2's read transaction is empty
0xaf	TRIO_MAP_RDQ3_BUF_EMPTY	The buffer of MAC3's read transaction is empty
0xb0	TRIO_MAP_RDQ4_BUF_EMPTY	The buffer of MAC4's read transaction is empty
0xb1	TRIO_MAP_RDQ5_BUF_EMPTY	The buffer of MAC5's read transaction is empty
0xb2	TRIO_MAP_RDQ6_BUF_EMPTY	The buffer of MAC6's read transaction is empty
0xb3	TRIO_MAP_RDQ7_BUF_EMPTY	The buffer of MAC7's read transaction is empty

## L3 Cache Performance Module

 **Note**

The L3 cache interfaces with the Arm cores via the SkyMesh. The CDN is used for control data. The NDN is used for responses. The DDN is for the actual data transfer.

Hex Value	Name	Description
0x00	DISABLE	Reserved for internal use
0x01	CYCLES	Timestamp counter
0x02	TOTAL_RD_REQ_IN	Read Transaction control request from the CDN of the SkyMesh
0x03	TOTAL_WR_REQ_IN	Write transaction control request from the CDN of the SkyMesh
0x04	TOTAL_WR_DBID_ACK	Write transaction control responses from the NDN of the SkyMesh
0x05	TOTAL_WR_DATA_IN	Write transaction data from the DDN of the SkyMesh
0x06	TOTAL_WR_COMP	Write completion response from the NDN of the SkyMesh
0x07	TOTAL_RD_DATA_OUT	Read transaction data from the DDN
0x08	TOTAL_CDN_REQ_IN_BAN_K0	CHI CDN Transactions Bank 0
0x09	TOTAL_CDN_REQ_IN_BAN_K1	CHI CDN Transactions Bank 1
0x0a	TOTAL_DDNN_REQ_IN_BAN_K0	CHI DDN Transactions Bank 0
0x0b	TOTAL_DDNN_REQ_IN_BAN_K1	CHI DDN Transactions Bank 1
0x0c	TOTAL_EMEM_RD_RES_IN_BANK0	Total EMEM Read Response Bank 0
0x0d	TOTAL_EMEM_RD_RES_IN_BANK1	Total EMEM Read Response Bank 1

Hex Value	Name	Description
0x0e	TOTAL_CACHE_RD_RES_IN_BANK0	Total Cache Read Response Bank 0
0x0f	TOTAL_CACHE_RD_RES_IN_BANK1	Total Cache Read Response Bank 1
0x10	TOTAL_EMEM_RD_REQ_BANK0	Total EMEM Read Request Bank 0
0x11	TOTAL_EMEM_RD_REQ_BANK1	Total EMEM Read Request Bank 1
0x12	TOTAL_EMEM_WR_REQ_BANK0	Total EMEM Write Request Bank 0
0x13	TOTAL_EMEM_WR_REQ_BANK1	Total EMEM Write Request Bank 1
0x14	TOTAL_RD_REQ_OUT	EMEM Read Transactions Out
0x15	TOTAL_WR_REQ_OUT	EMEM Write Transactions Out
0x16	TOTAL_RD_RES_IN	EMEM Read Transactions In
0x17	HITS_BANK0	Number of Hits Bank 0
0x18	HITS_BANK1	Number of Hits Bank 1
0x19	MISSES_BANK0	Number of Misses Bank 0
0x1a	MISSES_BANK1	Number of Misses Bank 1
0x1b	ALLOCATIONS_BANK0	Number of Allocations Bank 0
0x1c	ALLOCATIONS_BANK1	Number of Allocations Bank 1
0x1d	EVICTIONS_BANK0	Number of Evictions Bank 0
0x1e	EVICTIONS_BANK1	Number of Evictions Bank 1
0x1f	DBID_REJECT	Reserved for internal use
0x20	WRDB_REJECT_BANK0	Reserved for internal use
0x21	WRDB_REJECT_BANK1	Reserved for internal use
0x22	CMDQ_REJECT_BANK0	Reserved for internal use

Hex Value	Name	Description
0x23	CMDQ_REJECT_BANK1	Reserved for internal use
0x24	COB_REJECT_BANK0	Reserved for internal use
0x25	COB_REJECT_BANK1	Reserved for internal use
0x26	TRB_REJECT_BANK0	Reserved for internal use
0x27	TRB_REJECT_BANK1	Reserved for internal use
0x28	TAG_REJECT_BANK0	Reserved for internal use
0x29	TAG_REJECT_BANK1	Reserved for internal use
0x2a	ANY_REJECT_BANK0	Reserved for internal use
0x2b	ANY_REJECT_BANK1	Reserved for internal use

## PCIe TLR Statistics

Hex Value	Name	Description
0x0	PCIE_TLR_IN_P_PKT_CNT	Incoming posted packets
0x10	PCIE_TLR_IN_NP_PKT_CNT	Incoming non-posted packets
0x18	PCIE_TLR_IN_C_PKT_CNT	Incoming completion packets
0x20	PCIE_TLR_OUT_P_PKT_CNT	Outgoing posted packets
0x28	PCIE_TLR_OUT_NP_PKT_CNT	Outgoing non-posted packets
0x30	PCIE_TLR_OUT_C_PKT_CNT	Outgoing completion packets
0x38	PCIE_TLR_IN_P_BYTE_CNT	Incoming posted bytes
0x40	PCIE_TLR_IN_NP_BYTE_CNT	Incoming non-posted bytes
0x48	PCIE_TLR_IN_C_BYTE_CNT	Incoming completion bytes
0x50	PCIE_TLR_OUT_C_BYTE_CNT	Outgoing posted bytes
0x58	PCIE_TLR_OUT_NP_BYTE_CNT	Outgoing non-posted bytes
0x60	PCIE_TLR_OUT_C_BYTE_CNT	Outgoing completion bytes

# Tile HNFNET Performance Module

Hex Value	Name	Description
0x12	CDN_REQ	The number of CDN requests
0x13	DDN_REQ	The number of DDN requests
0x14	NDN_REQ	The number of NDN requests
0x15	CDN_DIAG_N_OUT_OF_CRED	Number of cycles that north input port FIFO runs out of credits in the CDN network
0x16	CDN_DIAG_S_OUT_OF_CRED	Number of cycles that south input port FIFO runs out of credits in the CDN network
0x17	CDN_DIAG_E_OUT_OF_CRED	Number of cycles that east input port FIFO runs out of credits in the CDN network
0x18	CDN_DIAG_W_OUT_OF_CRED	Number of cycles that west input port FIFO runs out of credits in the CDN network
0x19	CDN_DIAG_C_OUT_OF_CRED	Number of cycles that core input port FIFO runs out of credits in the CDN network
0x1a	CDN_DIAG_N_EGRES	Packets sent out from north port in the CDN network
0x1b	CDN_DIAG_S_EGRES	Packets sent out from south port in the CDN network
0x1c	CDN_DIAG_E_EGRES	Packets sent out from east port in the CDN network
0x1d	CDN_DIAG_W_EGRES	Packets sent out from west port in the CDN network
0x1e	CDN_DIAG_C_EGRES	Packets sent out from core port in the CDN network
0x1f	CDN_DIAG_N_INGRES	Packets received by north port in the CDN network
0x20	CDN_DIAG_S_INGRE	Packets received by south port in the CDN network

Hex Value	Name	Description
	SS	
0x21	CDN_DIAG_E_INGRESS	Packets received by east port in the CDN network
0x22	CDN_DIAG_W_INGRESS	Packets received by west port in the CDN network
0x23	CDN_DIAG_C_INGRESS	Packets received by core port in the CDN network
0x24	CDN_DIAG_CORE_SENT	Packets completed from core port in the CDN network
0x25	DDN_DIAG_N_OUT_OF_CRED	Number of cycles that north input port FIFO runs out of credits in the DDN network
0x26	DDN_DIAG_S_OUT_OF_CRED	Number of cycles that south input port FIFO runs out of credits in the DDN network
0x27	DDN_DIAG_E_OUT_OF_CRED	Number of cycles that east input port FIFO runs out of credits in the DDN network
0x28	DDN_DIAG_W_OUT_OF_CRED	Number of cycles that west input port FIFO runs out of credits in the DDN network
0x29	DDN_DIAG_C_OUT_OF_CRED	Number of cycles that core input port FIFO runs out of credits in the DDN network
0x2a	DDN_DIAG_N_EGRESS	Packets sent out from north port in the DDN network
0x2b	DDN_DIAG_S_EGRESS	Packets sent out from south port in the DDN network
0x2c	DDN_DIAG_E_EGRESS	Packets sent out from east port in the DDN network
0x2d	DDN_DIAG_W_EGRESS	Packets sent out from west port in the DDN network
0x2e	DDN_DIAG_C_EGRESS	Packets sent out from core port in the DDN network
0x2f	DDN_DIAG_N_INGR	Packets received by north port in the DDN network

Hex Value	Name	Description
	ESS	
0x30	DDN_DIAG_S_INGRESS	Packets received by south port in the DDN network
0x31	DDN_DIAG_E_INGRESS	Packets received by east port in the DDN network
0x32	DDN_DIAG_W_INGRESS	Packets received by west port in the DDN network
0x33	DDN_DIAG_C_INGRESS	Packets received by core port in the DDN network
0x34	DDN_DIAG_CORE_SENT	Packets completed from core port in the DDN network
0x35	NDN_DIAG_N_OUT_OF_CRED	Number of cycles that north input port FIFO runs out of credits in the NDN network
0x36	NDN_DIAG_S_OUT_OF_CRED	Number of cycles that south input port FIFO runs out of credits in the NDN network
0x37	NDN_DIAG_E_OUT_OF_CRED	Number of cycles that east input port FIFO runs out of credits in the NDN network
0x38	NDN_DIAG_W_OUT_OF_CRED	Number of cycles that west input port FIFO runs out of credits in the NDN network
0x39	NDN_DIAG_C_OUT_OF_CRED	Number of cycles that core input port FIFO runs out of credits in the NDN network
0x3a	NDN_DIAG_N_EGRESS	Packets sent out from north port in the NDN network
0x3b	NDN_DIAG_S_EGRESS	Packets sent out from south port in the NDN network
0x3c	NDN_DIAG_E_EGRESS	Packets sent out from east port in the NDN network
0x3d	NDN_DIAG_W_EGRESS	Packets sent out from west port in the NDN network
0x3e	NDN_DIAG_C_EGRESS	Packets sent out from core port in the NDN network

Hex Value	Name	Description
	SS	
0x3f	NDN_DIAG_N_INGRESS	Packets received by north port in the NDN network
0x40	NDN_DIAG_S_INGRESS	Packets received by south port in the NDN network
0x41	NDN_DIAG_E_INGRESS	Packets received by east port in the NDN network
0x42	NDN_DIAG_W_INGRESS	Packets received by west port in the NDN network
0x43	NDN_DIAG_C_INGRESS	Packets received by core port in the NDN network
0x44	NDN_DIAG_CORE_SENT	Packets completed from core port in the NDN network

## Programming Counter to Monitor Events

To program a counter to monitor one of the events from the event list, the event name or number needs to be written to the corresponding event file.

Let us call the `/sys/class/hwmon/hwmon<N>` folder corresponding to this driver as `BFPERF_DIR`.

For example, to monitor the event `HNF_REQUESTS` (0x45) on tile2 using counter 3:

```
$ echo 0x45 > <BFPERF_DIR>/tile2/event3
```

Or:

```
$ echo HNF_REQUESTS > <BFPERF_DIR>/tile2/event3
```

Once this is done, `counter3` resets the counter and starts monitoring the number of `HNF_REQUESTS`.

To read the counter value, run:

```
$ cat <BFPERF_DIR>/tile2/counter3
```

To see what event is currently being monitored by a counter, just read the corresponding event file to get the event name and number.

```
$ cat <BFPERF_DIR>/tile2/event3
```

In this case, reading the event3 file returns "0x45: HNF\_REQUESTS".

To clear the counter, write 0 to the counter file.

```
$ echo 0 > <BFPERF_DIR>/tile2/counter3
```

This resets the accumulator and the counter continues monitoring the same event that has previously been programmed, but starts the count from 0 again. Writing non-zero values to the counter files is not allowed.

To stop monitoring an event, write 0xff to the corresponding event file.

This is slightly different for the l3cache blocks due to the restriction that all counters can only be enabled, disabled, or reset together. So once the event is written to the event file, the counters will have to be enabled to start monitoring their respective events by writing "1" to the "enable" file. Writing "0" to this file will stop all the counters. The most reliable way to get accurate counter values would be by disabling the counters after a certain time period and then proceeding to read the counter values.

### **Note**

Programming a counter to monitor a new event automatically stops all the counters. Also, enabling the counters resets the counters to 0 first.

For blocks that have performance statistics registers (mechanism 2), all of these statistics are directly made available to be read or reset.

For example, to read the number of incoming posted packets to TRIO2:

```
$ cat <BFPERF_DIR>/pcie2/IN_P_PKT_CNT
```

The count can be reset to 0 by writing 0 to the same file. Again, non-zero writes to these files are not allowed.

## Intelligent Platform Management Interface

IPMB requests can be initiated in 2 directions:

- DPU BMC-to-BlueField
- BlueField-to-DPU BMC

### Note

The BlueField ipmb\_dev\_int driver is registered at the 7-bit I<sup>2</sup>C address 0x30 by default. The I<sup>2</sup>C address of the BlueField can be changed in the file /usr/bin/set\_emu\_param.sh.

- BlueField Controller cards provide connection from the host server BMC to BlueField Arm I<sup>2</sup>C bus
- BlueField DPUs provide connection from the host server BMC to the BlueField NC-SI port
- BlueField Reference Platforms provide connection from its on-board BMC to BlueField Arm I<sup>2</sup>C bus

# DPU BMC IPMI Commands

The DPU BMC is able to retrieve data from NVIDIA® BlueField® DPU software over its Intelligent Platform Management Bus (IPMB).

The DPU BMC may request information about itself using the following command format:

```
$ ipmitool <ipmitool command>
```

Issue a command with the following format from the DPU BMC to retrieve information from the BlueField:

```
ipmitool -I ipmb <ipmitool command>
```

The following table provides a list of supported ipmitool command arguments:

Command Description	ipmitool Command	Relevant IPMI 2.0 Rev 1.1 Spec Section
Get device ID	mc info	20.1
Broadcast "Get Device ID"	Part of "mc info"	20.9
Get BMC global enables	mc getenables	22.2
Get device SDR info	sdr info	35.2
Get device SDR	"sdr get", "sdr list" or "sdr elist"	35.3
Get sensor hysteresis	sdr get <sensor-id>	35.7
Set sensor threshold	sensor thresh <sensor-id> <threshold> <setting>	35.8

Command Description	ipmitool Command	Relevant IPMI 2.0 Rev 1.1 Spec Section
	<ul style="list-style-type: none"> <li>• sensor-id – name of the sensor for which a threshold is to be set</li> <li>• threshold – which threshold to set             <ul style="list-style-type: none"> <li>◦ ucr – upper critical</li> <li>◦ unc – upper non-critical</li> <li>◦ lnc – lower non-critical</li> <li>◦ lcr – lower critical</li> </ul> </li> <li>• setting – the value to set the threshold to</li> </ul> <p>To configure all lower thresholds, use : sensor thresh &lt;sensor-id&gt; lower &lt;lnr&gt; &lt;lcr&gt; &lt;lnc&gt;</p> <div style="background-color: #ffffcc; padding: 10px;"> <p> <b>Note</b> The lower non-recoverable &lt;lnr&gt; option is not supported</p> </div> <p>To configure all upper thresholds, use: sensor thresh &lt;sensor-id&gt; upper &lt;unc&gt; &lt;ucr&gt; &lt;unr&gt;</p> <div style="background-color: #ffffcc; padding: 10px;"> <p> <b>Note</b> The upper non-recoverable &lt;unr&gt; option is not supported</p> </div>	
Get sensor threshold	sdr get <sensor-id>	35.9
Get sensor event enable	sdr get <sensor-id>	35.11

Command Description	ipmitool Command	Relevant IPMI 2.0 Rev 1.1 Spec Section
Get sensor reading	sensor reading <sensor-id>	35.14
Get sensor type	sdr type <type>	35.16
Read FRU data	fru read <fru-number> <file-to-write-to>	34.2
Get SDR repository info	sdr info	33.9
Get SEL info	"sel" or "sel info"	40.2
Get SEL allocation info	"sel" or "sel info"	40.3
Get SEL entry	"sel list" or "sel elist"	40.5
Add SEL entry	sel add <filename>	40.6
Delete SEL entry	sel delete <id>	40.8
Clear SEL	sel clear	40.9
Get SEL time	sel time get	40.1
Set SEL time	sel time set "MM/DD/YYYY HH:M:SS"	40.11

## List of IPMI Supported Sensors

Sensor	ID	Description
bluefield_temp	0	Support NIC monitoring of BlueField's temperature
ddr0_0_temp <sup>1</sup>	1	Support monitoring of DDR0 temp (on memory controller 0)
ddr0_1_temp <sup>1</sup>	2	Support monitoring of DDR1 temp (on memory controller 0)

Sensor	ID	Description
ddr1_0_temp <sup>1</sup>	3	Support monitoring of DDR0 temp (on memory controller 1)
ddr1_1_temp <sup>1</sup>	4	Support monitoring of DDR1 temp (on memory controller 1)
p0_temp	5	Port 0 temperature
p1_temp	6	Port 1 temperature
p0_link	7	Port0 link status
p1_link	8	Port1 link status

1. On BlueField-2 and BlueField-3 based boards, DDR sensors and FRUs are not supported. They will appear as no reading. — — — —

## List of IPMI Supported FRUs

FR U	I D	Description
update_timer	0	set_emu_param.service is responsible for collecting data on sensors and FRUs every 3 seconds. This regular update is required for sensors but not for FRUs whose content is less susceptible to change. update_timer is used to sample the FRUs every hour instead. Users may need this timer in the case where they are issuing several raw IPMItool FRU read commands. This helps in assessing how much time users have to retrieve large FRU data before the next FRU update. update_timer is a hexadecimal number.
fw_i nfo	1	NVIDIA® ConnectX® firmware information, Arm firmware version, and MLNX_OFED version. The fw_info is in ASCII format.
nic_ pci_ dev_ inf o	2	NIC vendor ID, device ID, subsystem vendor ID, and subsystem device ID. The nic_pci_dev_info is in ASCII format.
cpui nfo	3	CPU information reported in lscpu and /proc/cpuinfo. The cpuinfo is in ASCII format.

FR U	I D	Description
ddr 0_0_ spd <u>2</u>	4	FRU for SPD MC0 DIMM 0 (MC = memory controller). The ddr0_0_spd is in binary format.
ddr 0_1_ spd <u>2</u>	5	FRU for SPD MC0 DIMM1. The ddr0_1_spd is in binary format.
ddr 1_0_ spd <u>2</u>	6	FRU for SPD MC1 DIMM0. The ddr1_0_spd is in binary format.
ddr 1_1_ spd <u>2</u>	7	FRU for SPD MC1 DIMM1. The ddr1_1_spd is in binary format.
em mc_ info	8	eMMC size, list of its partitions, and partitions usage (in ASCII format). eMMC CID, CSD, and extended CSD registers (in binary format). The ASCII data is separated from the binary data with "StartBinary" marker.
qsf p0_ eep rom	9	FRU for QSFP 0 EEPROM page 0 content (256 bytes in binary format)
qsf p1_ eep rom	10	FRU for QSFP 1 EEPROM page 0 content (256 bytes in binary format)
ip_a ddr ess es	11	This FRU file can be used to write the BMC port 0 and port 1 IP addresses to the BlueField. It is empty to begin with. The file passed through the ipmitool fru write 11 <file> command must have the following format: <div style="background-color: #f0f0f0; padding: 10px;"> BMC: XXX.XXX.XXX.XXX  P0: XXX.XXX.XXX.XXX  P1: XXX.XXX.XXX.XXX </div> The size of the written file should be exactly 61 bytes.
dim ms_	2	FRU reporting the number of correctable and uncorrectable errors in the DIMMs.

FR U	I D	Description
ce_ue		This FRU is updated once every 3 seconds.
eth_0	1 3	Network interface 0 information. Updated once every minute.
eth_1	1 4	Network interface 1 information. Updated once every minute.
bf_uid	1 5	BlueField UID
eth_hw_counters	1 6	List of ConnectX interface hardware counters

1. On BlueField-2 and BlueField-3 based boards, DDR sensors and FRUs are not supported. They will appear as no reading. \_\_\_\_\_

## BlueField IPMI Commands

The BlueField is able to retrieve data from the DPU BMC over IPMB.

Issue a command with the following format from the BlueField to retrieve information from the BMC:

```
$ ipmitool <ipmitool command>
```

The BlueField may request information about itself using the following command format:

```
$ ipmitool -U ADMIN -P ADMIN -p 9001 -H localhost <ipmitool command>
```

**(i) Note**

The ipmb\_host driver allows the BlueField to send requests to the BMC. Once set\_emu\_param.service is started, it will try to load the ipmb\_host drivers. If the BMC is down or not responsive when BlueField tries to load the ipmb\_host driver, the latter will not load successfully. In that case, make sure the BMC is up and operational, and run the following from BlueField's console:

```
echo 0x1011 > /sys/bus/i2c/devices/i2c-2/delete_device  
rmmod ipmb_host
```

The set\_emu\_param.service script will try to load the driver again.

## I2C Addresses for BMC-initiated Requests

Device	I <sup>2</sup> C Address
BlueField ipmb_dev_int	0x30
BMC ipmb_host	0x20

## I2C Addresses for BlueField-initiated Requests

Device	I <sup>2</sup> C Address
BlueField ipmb_host	0x11
BMC ipmb_dev_int	0x10

## Changing I2C Addresses

To use a different BlueField or BMC I<sup>2</sup>C address, you must make changes to the following files' variables.

Filename Path	Parameter Change
/usr/bin/set_emu_param.sh	<p>The ipmb_dev_int and ipmb_host drivers are registered at the following I<sup>2</sup>C addresses:</p> <ul style="list-style-type: none"> <li>• IPMB_DEV_INT_ADD=&lt;BlueField I2C Address 1&gt;</li> <li>• IPMB_HOST_ADD=&lt;BlueField I2C Address 2&gt;</li> </ul> <p>These addresses must be different from one another. Otherwise, one of the drives will fail to register.</p> <p>To change the BMC I<sup>2</sup>C address:</p> <pre style="background-color: #f0f0f0; padding: 10px;">IPMB_HOST_CLIENTADDR=&lt;BMC I2C Address&gt; &lt;I2C Address&gt; must be equal to: 0x1000+&lt;7-bit I2C address&gt;</pre>

## External Host IPMI Commands

It is possible for the external host to retrieve data from the BlueField via the IPMI LAN interface (either OOB or ConnectX).

To do that:

1. Set the network interface address properly in progconf. For example, if the OOB IP address is 192.168.101.2, edit the OOB\_IP variable in the /etc/ipmi/progconf file as follows:

```
root@localhost:~# cat /etc/ipmi/progconf
SUPPORT_IPMB="NONE"
LOOP_PERIOD=3
BF_FAMILY=$(/usr/bin/bffamily | tr -d '[:space:]')
OOB_IP="192.168.101.2"
```

2. Then reboot or restart the IPMI service as follows:

```
systemctl restart mlx_ipmid
```

3. To get information from the BlueField, issue commands from the external host in the following format:

```
ipmitool -I lanplus -H 192.168.101.2 -U ADMIN -P ADMIN <ipmitool command>
```

## Loading and Using IPMI on BlueField Running CentOS

1. Load the BlueField CentOS image:

### Note

The following steps are performed from the BlueField CentOS prompt. The BlueField is running CentOS 7.6 with kernel 5.4. The CentOS installation was done using the CentOS everything ISO image.

The following drivers need to be loaded on the BlueField running CentOS:

- jc42.ko
- ee1004.ko
- at24.ko
- eeprom.ko
- i2c-dev.ko

Example of loading ee1004.ko, at24.ko, and eeprom.ko:

```
modprobe ee1004
modprobe at24
modprobe eeprom
```

## Info

The i2c-dev module is built into the kernel 5.4.60 on CentOS 7.6.

2. (Optional) Update the i2c-mlx driver if the installed version is older than i2c-mlx-1.0-0.gab579c6.src.rpm.

1. Re-compile i2c-mlx. Run:

```
$ yum remove -y kmod-i2c-mlx  
$ modprobe -rv i2c-mlx
```

2. Transfer the i2c-mlx RPM from the BlueField software tarball under distro/SRPM onto the Arm. Run:

```
$ rpmbuild --rebuild /root/i2c-mlx-1.0-0.g422740c.src.rpm  
$ yum install -y /root/rpmbuild/RPMS/aarch64/i2c-mlx-1.0-0.g422740c_5.4.17_mlnx.9.ga0bea68.aarch64.rpm  
$ ls -l /lib/modules/$(uname -r)/extra/i2c-mlx/i2c-mlx.ko
```

3. Load i2c-mlx. Run:

```
$ modprobe i2c-mlx
```

3. Install the following packages:

```
$ yum install ipmitool lm_sensors
```

If the above operation fails for ipmitool, run the following to install it:

```
wget http://sourceforge.net/projects/ipmitool/files/ipmitool/1.8.18/ipmitool-1.8.18.tar.gz  
tar -xvzf ipmitool-1.8.18.tar.gz
```

```
cd ipmitool-1.8.18  
.bootstrap  
.configure  
make  
make install DESTDIR=/tmp/package-ipmitool
```

4. The i2c-tools package is also required, but the version contained in the CentOS Yum repository is old and does not work with BlueField. Therefore, please download i2c-tools version 4.1, and then build and install it.

```
# Build i2c-tools from a newer source  
wget http://mirrors.edge.kernel.org/pub/software/utils/i2c-tools/i2c-tools-  
4.1.tar.gz  
tar -xvzf i2c-tools-4.1.tar.gz  
cd i2c-tools-4.1  
make  
make install PREFIX=/usr  
  
# create a link to the libraries  
ln -sf /usr/lib/libi2c.so.0.1.1 /lib64/libi2c.so  
ln -sf /usr/lib/libi2c.so.0.1.1 /lib64/libi2c.so.0
```

5. Generate an RPM binary from the BlueField's mlx-OpenIPMI-2.0.25 source RPM.

The following packages might be needed to build the binary RPM depending on which version of CentOS you are using.

```
$ yum install libtool rpm-devel rpmdevtools rpmlint wget ncurses-devel  
automake  
$ rpmbuild --rebuild mlx-OpenIPMI-2.0.25-0.g581ebbb.src.rpm
```

 **Note**

You may obtain this rpm file by means of scp from the server host's Bluefield Distribution folder. For example:

```
$ scp <BF_INST_DIR>/distro/SRPMS/mlx-OpenIPMI-2.0.25-0.g4fdc53d.src.rpm <ip-address>:<target_directory>/
```

If there are issues with building the OpenIPMI RPM, verify that the swig package is not installed.

```
$ yum remove -y swig
```

6. Generate a binary RPM from the ipmb-dev-int source RPM and install it. Run:

```
$ rpmbuild --rebuild ipmb-dev-int-1.0-0.g304ea0c.src.rpm
```

7. Generate a binary RPM from the ipmb-host source RPM and install it. Run:

```
$ rpmbuild --rebuild ipmb-host-1.0-0.g304ea0c.src.rpm
```

8. Load OpenIPMI, ipmb-host, and ipmb-dev-int RPM packages. Run:

```
$ yum install -y /root/rpmbuild/RPMS/aarch64/mlx-OpenIPMI-2.0.25-0.g581ebbb_5.4.0_49.el7a.aarch64.aarch64.rpm  
$ yum install -y /root/rpmbuild/RPMS/aarch64/ipmb-dev-int-1.0-0.g304ea0c_5.4.0_49.el7a.aarch64.aarch64.rpm  
$ yum install -y /root/rpmbuild/RPMS/aarch64/ipmb-host-1.0-0.g304ea0c_5.4.0_49.el7a.aarch64.aarch64.rpm
```

9. Load the IPMB driver. Run:

```
$ modprobe ipmb-dev-int
```

10. Install and start rasdaemon package. Run:

```
yum install rasdaemon
```

```
systemctl enable rasdaemon  
systemctl start rasdaemon
```

11. Start the IPMI daemon. Run:

```
$ systemctl enable mlx_ipmid  
$ systemctl start mlx_ipmid  
$ systemctl enable set_emu_param  
$ systemctl start set_emu_param
```

## Redfish

Redfish provides a RESTful interface designed to manage IT infrastructure and is implemented using a modern toolchain (HTTP(s)/TLS/JSON).

Redfish supports the operations listed in this section.

## BIOS Configuration Schema

The BIOS schema contains properties related to the BIOS attribute registry. The attribute registry describes the system-specific BIOS attributes and actions for changing to BIOS settings. It is likely that a client finds the @Redfish.Settings term in this resource, and if it is found, the client makes requests to change BIOS settings by modifying the resource identified by the @Redfish.Settings annotation.

URI	/redfish/v1/Systems/{ComputerSystemId}/Bios
Schema file	<a href="http://redfish.dmtf.org/schemas/v1/Bios.v1_1_1.json">http://redfish.dmtf.org/schemas/v1/Bios.v1_1_1.json</a>
Operations	GET; PATCH

Example response:

```
{  
  "@Redfish.Settings": {  
    "@odata.type": "#Settings.v1_3_5.Settings",  
    "SettingsObject": {
```

```
"@odata.id": "/redfish/v1/Systems/Bluefield/Bios/Settings"
}
},
"@odata.id": "/redfish/v1/Systems/Bluefield/Bios",
"@odata.type": "#Bios.v1_2_0.Bios",
"Actions": {
  "#Bios.ChangePassword": {
    "target": "/redfish/v1/Systems/Bluefield/Bios/Actions/Bios.ChangePassword"
  },
  "#Bios.ResetBios": {
    "target": "/redfish/v1/Systems/Bluefield/Bios/Actions/Bios.ResetBios"
  }
},
"Attributes": {
  "Boot Partition Protection": false,
  "CurrentUefiPassword": "",
  "DateTime": "2024-04-24T19:56:59Z",
  "DefaultPasswordPolicy": true,
  "Disable PCIe": false,
  "Disable SPMI": false,
  "Disable TMFF": false,
  "EmmcWipe": false,
  "Enable 2nd eMMC": false,
  "Enable OP-TEE": false,
  "Enable SMMU": true,
  "Field Mode": false,
  "Host Privilege Level": "Privileged",
  "Internal CPU Model": "Embedded",
  "LegacyPasswordEnable": true,
  "NicMode": "DpuMode",
  "NvmeWipe": false,
  "OsArgs": "",
  "ResetEfiVars": false,
  "SPCR UART": "Disabled",
  "UefiArgs": "",
  "UefiPassword": ""
}
```

```
},
  "Description": "BIOS Configuration Service",
  "Id": "BIOS",
  "Links": {
    "SoftwareImages": [
      {
        "@odata.id": "/redfish/v1/UpdateService/FirmwareInventory/DPU_ATF"
      },
      {
        "@odata.id": "/redfish/v1/UpdateService/FirmwareInventory/DPU_BOARD"
      },
      {
        "@odata.id": "/redfish/v1/UpdateService/FirmwareInventory/DPU_BSP"
      },
      {
        "@odata.id": "/redfish/v1/UpdateService/FirmwareInventory/DPU_NIC"
      },
      {
        "@odata.id": "/redfish/v1/UpdateService/FirmwareInventory/DPU_NODE"
      },
      {
        "@odata.id": "/redfish/v1/UpdateService/FirmwareInventory/DPU_OFED"
      },
      {
        "@odata.id": "/redfish/v1/UpdateService/FirmwareInventory/DPU_OS"
      },
      {
        "@odata.id": "/redfish/v1/UpdateService/FirmwareInventory/DPU_SYS_IMAGE"
      },
      {
        "@odata.id": "/redfish/v1/UpdateService/FirmwareInventory/DPU_UEFI"
      }
    ],
    "SoftwareImages@odata.count": 9
  },
  "Name": "BIOS Configuration",
```

```

    "ResetBiosToDefaultsPending": false
}

```

The following table explains each of the attributes listed in the code:

Attribute	Description
Boot Partition Protection	See description in section " <a href="#">System Configuration</a> "
CurrentUefiPassword	See "Set Password" in section " <a href="#">System Configuration</a> "
DateTime	See "Set RTC" in section " <a href="#">System Configuration</a> "
DefaultPasswordPolicy	See "Password Settings" in section " <a href="#">System Configuration</a> "
Disable PCIe	See description in section " <a href="#">System Configuration</a> "
Disable SPMI	See description in section " <a href="#">System Configuration</a> "
Disable TMFF	See description in section " <a href="#">System Configuration</a> "
EmmcWipe	See description in section " <a href="#">System Configuration</a> "
Enable 2nd eMMC	See description in section " <a href="#">System Configuration</a> "
Enable OP-TEE	See description in section " <a href="#">System Configuration</a> "
Enable SMMU	See description in section " <a href="#">System Configuration</a> "
Field Mode	See description in section " <a href="#">System Configuration</a> "
Host Privilege Level	See "BlueField Modes" in section " <a href="#">System Configuration</a> "
Internal CPU Model	See "BlueField Modes" in section " <a href="#">System Configuration</a> "
LegacyPasswordEnable	See "Password Settings" in section " <a href="#">System Configuration</a> "
NicMode	See "BlueField Modes" under section " <a href="#">System Configuration</a> "
NvmeWipe	See description in section " <a href="#">System Configuration</a> "
OsArgs	Arguments to pass to the OS kernel
ResetEfiVars	See "Reset EFI Variables" in section " <a href="#">System Configuration</a> "
SPCR UART	See "Select SPCR UART" in section " <a href="#">System Configuration</a> "
UefiArgs	Arguments to pass to the UEFI
UefiPassword	See "Set Password" in section " <a href="#">System Configuration</a> "

# BlueField Platform Inventory

The BlueField Platform provides inventory information in the ComputerSystemCollection schema. To identify the DPU ComputerSystem instance, fetch the ComputerSystemCollection first.

DPIs are identified with the SystemType attribute DPU. The DPU instance identifier value (DPU.Embedded.1\_NIC.Slot.2 in this case) differs from one server vendor to another but will uniquely identify the DPU in all cases.

The following is a simple example of fetching Redfish inventory information from a server's BMC:

```
root@localhost:~$ python3 /usr/local/bin/redfishtool.py -r <bmc_ip> -u <USER> -p
<PASSWORD> raw GET /redfish/v1/Systems/
{
  "@odata.context": "/redfish/v1/$metadata#ComputerSystemCollection.ComputerSystemCollection",
  "@odata.id": "/redfish/v1/Systems",
  "@odata.type": "#ComputerSystemCollection.ComputerSystemCollection",
  "Description": "Collection of Computer Systems",
  "Members": [
    {
      "@odata.id": "/redfish/v1/Systems/System.Embedded.1"
    },
    {
      "@odata.id": "/redfish/v1/Systems/DPU.Embedded.1_NIC.Slot.2"
    }
  ],
  "Members@odata.count": 2,
  "Name": "Computer System Collection"
}

root@localhost:~$ python3 /usr/local/bin/redfishtool.py -r <bmc_ip> -u <USER> -p
<PASSWORD> raw GET /redfish/v1/Systems/DPU.Embedded.1_NIC.Slot.2
{
  "@odata.context": "/redfish/v1/$metadata#ComputerSystem.ComputerSystem",
```

```
"@odata.id": "/redfish/v1/Systems/DPU.Embedded.1_NIC.Slot.2",
"@odata.type": "#ComputerSystem.v1_12_0.ComputerSystem",
"Actions": {
  "#ComputerSystem.Reset": {
    "target": "/redfish/v1/Systems/DPU.Embedded.1_NIC.Slot.2/Actions/ComputerSystem.Reset",
    "ResetType@Redfish.AllowableValues": [
      "ForceRestart",
      "Nmi"
    ]
  }
},
"Bios": {
  "@odata.id": "/redfish/v1/Systems/DPU.Embedded.1_NIC.Slot.2/Bios"
},
"BiosVersion": null,
"Boot": {
  "BootOptions": {
    "@odata.id": "/redfish/v1/Systems/DPU.Embedded.1_NIC.Slot.2/BootOptions"
  },
  "BootOrder": [],
  "BootOrder@odata.count": 0,
  "BootSourceOverrideEnabled": null,
  "BootSourceOverrideMode": null,
  "BootSourceOverrideTarget": null,
  "UefiTargetBootSourceOverride": null,
  "BootSourceOverrideTarget@Redfish.AllowableValues": []
},
"Description": "DPU System",
"Id": "DPU.Embedded.1_NIC.Slot.2",
"Manufacturer": "DELL",
"Model": "NVIDIA Bluefield-2 25GbE 2p Crypto DPU",
"Name": "DPU System",
```

```
"Oem": {
  "Dell": {
    "@odata.type": "#DellComputerSystem.v1_1_0.DellComputerSystem",
    "DPUConfig": {
      "FQDD": "DPU.Embedded.1:NIC.Slot.2",
      "BootStatus": "OSBooting",
      "DPUBootSynchronization": "Enabled",
      "DPUTrust": "Enabled",
      "IdenticalSBDF": [
        "0:23:0:0",
        "0:23:0:1"
      ],
      "LastResetReason": null,
      "OSName": null,
      "OSReadyTimeout": 20,
      "OSInstallationTimeout": 30,
      "OSVersion": null,
      "OSVendor": null,
      "OSStatus": "Unknown",
      "Slot": "2",
      "PCleSlotState": "Enabled",
      "PostCode": null,
      "VendorID": "0x15B3",
      "DeviceID": "0xA2D6",
      "SubVendorID": "0x15B3",
      "SubDeviceID": "0x0129"
    },
    "Name": "DPUConfig",
    "Id": "DPU.Embedded.1_NIC.Slot.2"
  }
},
"PartNumber": "JNDCMX01",
"SecureBoot": {
  "@odata.id": "/redfish/v1/Systems/DPU.Embedded.1_NIC.Slot.2/SecureBoot"
},
"SerialNumber": "IL740311A5000A",
```

```
"SKU": "0JNDCM",
"Status": {
    "Health": "Ok",
    "HealthRollup": "Ok",
    "State": "Enabled"
},
"SystemType": "DPU",
"UUID": "ec6dd921-882a-ec11-8000-08c0eb5180ba",
"@Redfish.Settings": {
    "@odata.context": "/redfish/v1/$metadata#Settings.Settings",
    "@odata.type": "#Settings.v1_3_3.Settings",
    "SettingsObject": {
        "@odata.id": "/redfish/v1/Systems/DPU.Embedded.1_NIC.Slot.2/Settings"
    }
}
}
```

## Boot Override

This example demonstrates how to boot a BlueField Platform while overriding the existing boot options and using HTTP boot to obtain the image.

Check the current boot override settings by doing a GET on ComputerSystem schema. Look for the Boot property.

```
curl -vk -X GET -u "user:password" https://<bmc_ip>/redfish/v1/Systems/SystemId/ |
python3 -m json.tool
{
...
"Boot": {
    "BootNext": "",
    "BootOrderPropertySelection": "BootOrder",
    "BootSourceOverrideEnabled": "Disabled",
    "BootSourceOverrideMode": "UEFI",
    "BootSourceOverrideTarget": "None",
    "UefiTargetBootSourceOverride": "None",
}
```

```

.....
},
.....
"BootSourceOverrideEnabled@Redfish.AllowableValues": [
    "Once",
    "Continuous",
    "Disabled"
],
"BootSourceOverrideTarget@Redfish.AllowableValues": [
    "None",
    "Pxe",
    "UefiHttp",
    "UefiShell",
    "UefiTarget",
    "UefiBootNext"
],
.....
}

```

The sample output above shows the BootSourceOverrideEnabled property is Disabled and BootSourceOverrideTarget is None. The BootSourceOverrideMode property should always be set to UEFI. Allowable values of BootSourceOverrideEnabled and BootSourceOverrideTarget are defined in the meta-data BootSourceOverrideEnabled@Redfish.AllowableValues and BootSourceOverrideTarget@Redfish.AllowableValues respectively.

To perform boot override, you must perform a PATCH to pending settings URI:

```

curl -vk -X PATCH -d '{"Boot": {"BootSourceOverrideEnabled": "Once",
"BootSourceOverrideMode": "UEFI", "BootSourceOverrideTarget": "UefiHttp",
"HttpBootUri": "http://<HTTP-Server-Ip>/Image.iso"} }' -u "user:password"
https://<bmc_ip>/redfish/v1/Systems/SystemId/Settings | python3 -m json.tool

```

After performing the above PATCH successfully, reboot the BlueField Platform. Once UEFI has completed, check whether the settings are applied by performing a GET on ComputerSystem schema.

Note that the `HttpBootUri` property is parsed by the Redfish server and the URI is presented to the DPU as part of DHCP lease when the DPU performs the HTTP boot.

```
curl -vk -X GET -u "user:password" https://<bmc_ip>/redfish/v1/Systems/SystemId/ |  
python3 -m json.tool  
{  
...  
"Boot": {  
"BootNext": "",  
"BootOrderPropertySelection": "BootOrder",  
"BootSourceOverrideEnabled": "Once",  
"BootSourceOverrideMode": "UEFI",  
"BootSourceOverrideTarget": "UefiHttp",  
"UefiTargetBootSourceOverride": "None",  
.....  
},  
.....  
}
```

After confirming the settings are applied (see PATCH properties above), reboot the DPU for the settings to take effect. If `BootSourceOverrideEnabled` is set to `Once`, boot override is disabled and any related properties are reset to their former values to avoid repetition. If it is set to `Continuous`, then on every reboot the DPU will keep performing boot override (HTTPBoot).

## Boot Order

The following is an example of changing the boot order and fetching the details of a boot option.

1. Check the current boot order by doing GET on the `ComputerSystem` schema. Look for the `BootOrder` attribute under the `Boot` property.
2. Get the details of a particular entity in the `BootOrder` array by performing a GET to the respective `BootOption` URL. For example, to get details of `Boot0006`, run:

```
curl -vk -X GET -u "user:password"  
https://<bmc_ip>/redfish/v1/Systems/SystemId/BootOptions/Boot0006 |  
python3 -m json.tool  
  
{  
    "@odata.type": "#BootOption.v1_0_3.BootOption",  
    "@odata.id": "/redfish/v1/Systems/SystemId/BootOptions/Boot0006",  
    "Id": "Boot0006",  
    "BootOptionEnabled": true,  
    "BootOptionReference": "Boot0006",  
    "DisplayName": "UEFI HTTPv6 (MAC:B8CEF6B8A006)",  
    "UefiDevicePath":  
        "PciRoot(0x0)/Pci(0x0,0x0)/Pci(0x0,0x0)/Pci(0x0,0x0)/Pci(0x0,0x0)/MAC(B8CEF6B8",  
}
```

3. To change the boot order, the entire BootOrder array must be PATCHed to the pending settings URI. For the above example of the BootOrder array, if you intend to have Boot0006 at the beginning of the array, then the PATCH operation is as follows.

```
curl -vk -X PATCH -d '{ "Boot": { "BootOrder": [ "Boot0006", "Boot0017",  
"Boot0001", "Boot0002", "Boot0003", "Boot0004", "Boot0005", "Boot0007", ] }}'  
-u "user:password" https://<bmc_ip>/redfish/v1/Systems/SystemId/Settings |  
python3 -m json.tool
```

### Note

Updating the BootOrder array results in a permanent boot order change (persistent across reboots).

After a successful PATCH, reboot the DPU and check if the settings were applied by doing a GET on the ComputerSystem schema. If the BootOrder array is updated as intended, then the settings were applied and the BlueField Platform should boot as per the order in proceeding cycles.

# BIOS Attributes

The following is an example of fetching and setting a DPU BIOS attribute.

1. Check UEFI attributes and their values by doing a GET on Bios URL. Look for Attributes property.

```
curl -vk -X GET -u "user:password"
https://<bmc_ip>/redfish/v1/Systems/SystemId/Bios | python3 -m json.tool

{
...
"Attributes": {
    "Boot Partition Protection": false,
    "CurrentUefiPassword": "",
    "DateTime": "2022-07-05T16:02:12Z",
    "Disable PCIe": false,
    "Disable SPMI": false,
    "Disable TMFF": false,
    "Enable 2nd eMMC": false,
    "Enable OP-TEE": false,
    "Enable SMMU": true,
    "Field Mode": false,
    "Host Privilege Level": "Privileged",
    "Internal CPU Model": "Embedded",
    "ResetEfiVars": false,
    "SPCR UART": "Disabled",
    "UefiPassword": ""
},
...
}
```



## Note

For Security reasons, CurrentUefiPassword and UefiPassword strings might be empty.

2. The following example updates the UEFI password. Perform PATCH to Bios pending settings URI as follows:

```
curl -vk -X PATCH -d '{"Attributes":{"CurrentUefiPassword": "CURRENTPASSWD", "UefiPassword": "NEWPASSWORD"}}' -u "user:password"  
https://<bmc_ip>/redfish/v1/Systems/SystemId/Bios/Settings | python3 -m  
json.tool
```

 **Note**

To update the password, both the current password and the new password (requesting) should be specified as demonstrated above. Otherwise, the change does not work. To modify other attributes no password is required.

3. To confirm whether the PATCH request is successful, perform a GET to the BIOS pending settings URI:

```
curl -vk -X GET -u "user:password"  
https://<bmc_ip>/redfish/v1/Systems/SystemId/Bios/Settings | python3 -m  
json.tool
```

4. For requests to take effect, reboot the DPU. If the CurrentUefiPassword is correct, then the UEFI password is updated during the UEFI Redfish phase of boot.

 **Info**

The UEFI password is only required to enter the UEFI menu using the serial console.

# Logging

## RShim Logging

RShim logging uses an internal 1KB HW buffer to track booting progress and record important messages. It is written by the NVIDIA ® BlueField ® Arm cores and is displayed by the RShim driver from the USB/PCIe host machine. Starting in release 2.5.0, ATF has been enhanced to support the RShim logging.

The RShim log messages can be displayed described in the following:

1. Check the DISPLAY\_LEVEL level in file /dev/rshim0/misc.

```
# cat /dev/rshim0/misc
DISPLAY_LEVEL 0 (0:basic, 1:advanced, 2:log)
...
```

2. Set DISPLAY\_LEVEL to 2.

```
# echo "DISPLAY_LEVEL 2" > /dev/rshim0/misc
```

3. Log messages are displayed in the misc file.

The following is an example output for BlueField-2:

```
# cat /dev/rshim0/misc
...
-----
Log Messages
-----
INFO[BL2]: start
```

INFO[BL2]: no DDR on MSS0  
 INFO[BL2]: calc DDR freq (clk\_ref 53836948)  
 INFO[BL2]: DDR POST passed  
 INFO[BL2]: UEFI loaded  
 INFO[BL31]: start  
 INFO[BL31]: runtime  
 INFO[UEFI]: eMMC init  
 INFO[UEFI]: eMMC probed  
 INFO[UEFI]: PCIe enum start  
 INFO[UEFI]: PCIe enum end

The following table details the ATF/UEFI messages for BlueField-2 and BlueField-3:

Message	Explanation	Action
INFO[BL2]: start	BL2 started	Informational
INFO[BL2]: no DDR on MSS<N>	DDR is not detected on memory controller <N>	Informational (depends on device)
INFO[BL2]: calc DDR freq (clk_ref 156M, clk xxx)	DDR frequency is calculated based on reference clock 156M	Informational
INFO[BL2]: calc DDR freq (clk_ref 100M, clk xxx)	DDR frequency is calculated based on reference clock 100M	Informational
INFO[BL2]: calc DDR freq (clk_ref xxxx)	DDR frequency is calculated based on reference clock xxxx	Informational
INFO[BL2]: DDR POST passed	BL2 DDR training passed	Informational
INFO[BL2]: UEFI loaded	UEFI image is loaded successfully in BL2	Informational
ERR[BL2]: DDR init fail on MSS<N>	DDR initialization failed on memory controller <N>	Informational (depends on device)

Message	Explanation	Action
ERR[BL2]: image <N> bad CRC	Image with ID <N> is corrupted which will cause hang	Error message. Reset the device and retry. If problem persists, use a different image to retry it.
ERR[BL2]: DDR BIST failed	DDR BIST failed	Need to retry. Check the ATF booting message whether the detected OPN is correct or not, or whether it is supported by this image. If still fails, contact NVIDIA Support.
ERR[BL2]: DDR BIST Zero Mem failed	DDR BIST failed in the zero-memory operation	Power-cycle and retry. If the problem persists, contact your NVIDIA FAE.
WARN[BL2]: DDR frequency unsupported	DDR training is programmed with unsupported parameters	Check whether official FW is being used. If the problem persists, contact your NVIDIA FAE.
WARN[BL2]: DDR min- sys(unknown)	System type cannot be determined and boot as a minimal system	Check whether the OPN or PSID is supported. If the problem persists, contact your NVIDIA FAE.
WARN[BL2]: DDR min- sys(misconf)	System type misconfigured and boot as a minimal system	Check whether the OPN or PSID is supported. If the problem persists, contact your NVIDIA FAE.
Exception(BL2): syndrome = xxxxxxxx ...	Exception in BL2 with syndrome code and register dump. System hung.	Capture the log, analyze the cause, and report to FAE if needed
PANIC(BL2): PC = xxx ...	Panic in BL2 with register dump. System will hung.	Capture the log, analyze the cause, and report to FAE if needed
ERR[BL2]: load/auth failed	Failed to load image (non-existent/corrupted), or image authentication failed when secure boot is enabled	Try again with the correct and properly signed image
INFO[BL31]: start	BL31 started	Informational

Message	Explanation	Action
INFO[BL31]: runtime	BL31 enters the runtime state. This is the latest BL31 message in normal booting process.	Informational
Exception(BL31 ): syndrome = xxxxxxxx cptr_el3 xx daif xx ...	Exception in BL31 with syndrome code and register dump. System hung.	Capture the log, analyze the cause, and report to FAE if needed
PANIC(BL31): PC = xxx cptr_el3 xxx daif xx ...	Panic in BL31 with register dump. System hung.	Capture the log, analyze the cause, and report to FAE if needed
INFO[UEFI]: eMMC init	eMMC driver is initialized	Informational and should always be printed
INFO[UEFI]: eMMC probed	eMMC card is initialized	Informational and should always be printed
ASSERT(UEFI): xxx : line-no	Runtime assert message in UEFI	Contact your NVIDIA FAE with this information. Usually the system is able to continue running.
INFO[UEFI]: PCIe enum start	PCIe enumeration start	Informational
INFO[UEFI]: PCIe enum end	PCIe enumeration end	Informational
ERR[UEFI]: Synchronous Exception at xxxxxx ERR[UEFI]: PC=xxxxxx ERR[UEFI]: PC=xxxxxx ...	UEFI Exception with PC value reported	Contact your NVIDIA FAE with this information
ERR[BL2]:FW auth failed	Image authentication error	Wrong image has been used in the current secure lifecycle. Switch to the correct image.

Message	Explanation	Action
ERR[BL2]: IROT cert sig not found	Failed to load attestation certificates	Contact your NVIDIA FAE with this information
ERR[BL2]: IROT cert sig not found	Failed to load certification update record	Contact your NVIDIA FAE with this information
	<p><b>i Info</b> Only relevant for certain BlueField-3 DPUs.</p>	
INFO[BL31]: PSC Turtle Mode detected	PSC enters turtle mode	Informational
	<p><b>i Info</b> BlueField-3 only.</p>	
INFO[BL31]: In Enhanced NIC mode	BlueField-3 enters enhanced NIC mode	Informational
ERR[BL31]: (set_page err   pmbus_lsb err   mfr_vr_mc err   set_vout err)	BlueField-3 power management programming error.	Contact your NVIDIA FAE with this information
	<p><b>i Info</b> Usually happens when the I2C voltage regulator is not accessible.</p>	

Message	Explanation	Action
INFO [BL31]: MB8: VDD adjustment complete	BlueField-3 MainBin 8-core board VDD CPU adjustment	Informational
INFO [BL31]: VDD adjustment complete	BlueField-3 (non-8-core board) VDD CPU adjustment	Informational
INFO [BL31]: VDD: xxx mV	BlueField-3 VDD CPU voltage	Informational
ERR[BL31]: cannot access vr0 (or access vr1)	BlueField-3 unable to access voltage regulator (vr0 or vr1) via I2C	Contact your NVIDIA FAE with this information
ERR[BL31]: ATX power not detected!	ATX power is not connected	Contact your NVIDIA FAE with this information
INFO[BL31]: PTMERROR: Unknown OPN	Unable to detect the OPN on this device	Contact your NVIDIA FAE with this information
INFO[BL31]: PTMERROR: VR access error	Unable to access the voltage regulator on this device	<p><b>i Info</b></p> <p>This also means power capping will be disabled.</p>
INFO[BL31]: power capping disabled	BlueField-3 power capping disabled	Informational
INFO[BL2]: boot mode (rshim   emmc   unknown)	Device boot mode (from external RShim or eMMC)	Informational

Message	Explanation	Action
ERR[BL31]: ECC_SINGLE_ER ROR_CNT=xxx	Single ECC error counter report	Contact your NVIDIA FAE with this information
ERR[BL31]: ECC_DOUBLE_E RROR_CNT=xxx	Double ECC error counter report	Contact your NVIDIA FAE with this information
ERR[BL31]: mss0 mss1: C0 C1 single- bit ecc, IRQ[%d]	MSS (0 or 1) channel (0 or 1) single-bit ECC error interrupt #	Contact your NVIDIA FAE with this information
ERR[BL31]: mss0 mss1: C0 C1 Double bit ecc, IRQ[%d]	MSS (0 or 1) channel (0 or 1) double-bit ECC error interrupt #	Contact your NVIDIA FAE with this information
ERR[BL31]: Double-bit ECC also detected in same buffer	Single/double ECC error detected in the same buffer	Contact your NVIDIA FAE with this information
ERR[BL31]: I3c: double-bit ecc	L3c double-bit ECC error detected	Contact your NVIDIA FAE with this information
ERR[BL31]: MSS%d DIMM%d single double bit ECC error detected	MSS DRAM single (or double) bit error detected	Contact your NVIDIA FAE with this information
ERR[BL31]: MSS%d SRAM double bit ECC error detected	MSS SRAM double bit ECC error detected	Contact your NVIDIA FAE with this information

## IPMI Logging in UEFI

During UEFI boot, the BlueField sends IPMI SEL messages over IPMB to the BMC in order to track boot progress and report errors. The BMC must be in responder mode to receive the log messages.

## SEL Record Format

The following table presents standard SEL records (record type = 0x02).

Byte(s)	Field	Description
1 2	Record ID	ID used to access SEL record. Filled in by the BMC. Is initialized to zero when coming from UEFI.
3	Record Type	Record type
4 5 6 7	Timestamp	Time when event was logged. Filled in by BMC. Is initialized to zero when coming from UEFI.
8 9	Generator ID	This value is always 0x0001 when coming from UEFI
10	EvM Rev	Event message format revision which provides the version of the standard a record is using. This value is 0x04 for all records generated by UEFI.
11	Sensor Type	Sensor type code for sensor that generated the event
12	Sensor Number	Number of the sensor that generated the event. These numbers are arbitrarily chosen by the OEM.
13	Event Dir   Event Type	[7] – 0b0 = Assertion, 0b1 = Deassertion [6:0] – Event type code
14	Event Data 1	[7:6] – Type of data in Event Data 2 <ul style="list-style-type: none"> <li>• 0b00 = unspecified</li> <li>• 0b10 = OEM code</li> <li>• 0b11 = Standard sensor-specific event extension</li> </ul> [5:4] – Type of data in Event Data 3 <ul style="list-style-type: none"> <li>• 0b00 = unspecified</li> <li>• 0b10 = OEM code</li> <li>• 0b11 = Standard sensor-specific event extension</li> </ul> [3:0] – Event Offset; offers more detailed event categories. See <i>IPMI 2.0 Specification</i> section 29.7 for more detail.

Byte(s)	Field	Description
15	Event Data 2	Data attached to the event. 0xFF for unspecified. Under some circumstances, this may be used to specify more detailed event categories.
16	Event Data 3	Data attached to the event. 0xFF for unspecified.

See *IPMI 2.0 Specification* section 32.1 for more detail.

## Possible SEL Field Values

BlueField UEFI implements a subset of the IPMI 2.0 SEL standard. Each field may have the following values:

Field	Possible Values	Description of Values
Record Type	0x02	Standard SEL record. All events sent by UEFI are standard SEL records.
Event Dir	0b0	All events sent by UEFI are assertion events
Event Type	0x6F	Sensor-specific discrete events. Events with this type do not deviate from the standard.
Sensor Number	0x06	UEFI boot progress “sensor”. If value is 0x06, the sensor type will always be “System Firmware Progress” (0x0F).

For Sensor Type, Event Offset, and Event Data 1-3 definitions, see next table.

## Event Definitions

Events are defined by a combination of Record Type, Event Type, Sensor Type, Event Offset (occupies Event Data 1), and sometimes Event Data 2 (referred to as the Event Extension if it defines sub-events).

The following tables list all currently implemented IPMI events (with Record Type = 0x02, Event Type = 0x6F).

 **Note**

Note that if an Event Data 2 or Event Data 3 value is not specified, it can be assumed to be Unspecified (0xFF).

Sensor Type	Sensor Type Code	Event Offset	Event Description, Actions to Take
System Firmware Progress	0x0F	0x00	<p>System firmware error (POST error). Event Data 2:</p> <ul style="list-style-type: none"><li>• 0x06 – Unrecoverable EMMC error. Contact NVIDIA support.</li></ul>
		0x02	<p>System firmware progress: Informational message, no actions needed. Event Data 2:</p> <ul style="list-style-type: none"><li>• 0x02 – Hard Disk Initialization. Logged when EMMC is initialized.</li><li>• 0x04 – User Authentication. Logged when a user enters the correct UEFI password. This event is never logged if there is no UEFI password.</li><li>• 0x07 – PCI Resource Configuration. Logged when PCI enumeration has started.</li><li>• 0x0B – SMBus Initialization. This event is logged as soon as IPMB is configured in UEFI.</li><li>• 0x13 – Starting OS Boot Process. Logged when Linux begins booting.</li></ul>

# Reading IPMI SEL Log Messages

Log messages may be read from the BMC by issuing it a “Get SEL Entry Command” while it is in responder mode, either from a remote host, or from the BlueField DPU itself once it is booted.

```
$ ipmitool sel list
7b | Pre-Init |0000691604| System Firmwares #0x06 | SMBus initialization |
Asserted
7c | Pre-Init |0000691604| System Firmwares #0x06 | Hard-disk initialization |
Asserted
7d | Pre-Init |0000691654| System Firmwares #0x06 | System boot initiated
$ ipmitool sel get 0x7d
SEL Record ID : 007d
Record Type : 02
Timestamp : 01/09/1970 00:07:34
Generator ID : 0001
EvM Revision : 04
Sensor Type : System Firmwares
Sensor Number : 06
Event Type : Sensor-specific Discrete
Event Direction : Assertion Event
Event Data : c213ff
Description : System boot initiated
$ ipmitool sel clear
Clearing SEL. Please allow a few seconds to erase.
$ ipmitool sel list
SEL has no entries
```

# ACPI BERT Logging

ACPI boot error record table (BERT) is supported to log last boot error in Linux. Once Linux printk is enabled (e.g., by adding "kernel.printk=8" to /etc/sysctl.conf), it will try to report the errors automatically for last boot. The following is an example of such error reports:

```
[ 2.635539] BERT: Error records from previous boot:  
[ 2.640434] [Hardware Error]: event severity: fatal  
[ 2.645331] [Hardware Error]: Error 0, type: fatal  
[ 2.650236] [Hardware Error]: section type: unknown, c6adf9e6-1108-4760-8827-  
003d059fe2e1  
[ 2.658606] [Hardware Error]: section length: 0x35  
[ 2.663580] [Hardware Error]: 00000000: 52524520 4645555b 203a5d49 0a0d0a0d  
ERR[UEFI]: ....  
[ 2.672284] [Hardware Error]: 00000010: 636e7953 6e6f7268 2073756f 65637845  
Synchronous Exce  
[ 2.680987] [Hardware Error]: 00000020: 6f697470 7461206e 36783020 37313643  
ption at 0x6C617  
[ 2.689696] [Hardware Error]: 00000030: 34 37 30 0d 0a  
...
```

## SoC Management Interface

The SoC management interface, formerly known as RShim, allows an external agent such as the host CPU or BMC to operate the DPU and monitor its operational state. This interface allows provisioning of the DPU, resetting Arm cores, and obtaining logs.

### Note

For instructions for Windows support, please refer to page "[Windows Support](#)".

## Installation and Upgrade

Please refer to section [Updating Repo Package on Host Side](#).

## Configuration File

The configuration file for the SoC management interface is located at `/etc/rshim.conf` and includes the parameters listed in the table below.

Parameter	Default	Description
BOOT_TIMEOUT	150	Timeout value in seconds when pushing BFB while Arm side is not reading the boot stream.
DROP_MODE	0	Once set to 1, the RShim driver ignores all RShim writes and returns 0 for RShim read. This is used in cases such as during FW_RESET or bypassing the RShim PF to VM.
PCIE_RESET_DELAY	10	Delay in seconds for RShim over PCIe, which is added after chip reset and before pushing the boot stream.
PCIE_INTR_POLL_INTERVAL	10	Interrupt polling interval in seconds when running RShim over direct memory mapping.
PCIE_HAS_VFIO	1	Setting this parameter to 0 disallows RShim memory mapping via VFIO.
PCIE_HAS_UIO	1	Setting this parameter to 0 disallows RShim memory mapping via UIO.

 **Note**

Configuring RShim is optional. The default parameters are designed to support out-of-box deployment scenarios including multiple DPUs on a single host.

Users may control which RShim index maps to which device by following this procedure:

```
# Uncomment the 'rshim<N>' line to configure the mapping.  
#  
# device-name pci-device  
rshim0    pcie-0000:21:00.2
```

```
rshim1    pcie-0000:81:00.2

#
# Ignored devices.
# Uncomment the 'none' line to configure the ignored devices.
#
#none      usb-1-1.4
#none      pcie-lf-0000:84:00.0
```

### Note

If any of these configurations are changed, then the SoC management interface must be restarted by running:

```
systemctl restart rshim
```

## Host-side Interface Configuration

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 SoC management driver must be installed and run on the host OS to expose the various BlueField management interfaces to the OS. Currently, this driver is named RShim and is automatically installed as part of the DOCA installation. Refer to section "[Install RShim on Host](#)" for information on how to obtain and install the host-side SoC management interface driver .

When the SoC management interface 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 SoC management interface 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 So...
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
```

If the SoC management interface driver device does not appear, refer to section "["RShim Troubleshooting and How-Tos"](#)".

## Virtual Ethernet Interface

On the host, the SoC management interface 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
```

 **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
```

## SoC Management Interface Driver Support for Multiple DPUs

Multiple DPUs may connect to the same host machine. When the SoC management interface driver is loaded and operating correctly, each BlueField device is expected to have its own device directory on sysfs, /dev/rshim<N>, and a virtual Ethernet device, tmfifo\_net<N>.

 **Note**

<N> correlates to the number of BlueField DPUs used where the SoC management interfaces of the first DPU is 0, incrementing by 1 for each added BlueField.

The following are some guidelines on how to set up the SoC management 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 bares 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). The 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.

### **Note**

For comprehensive list of the supported parameters to customize bf.cfg during BFB installation, refer to section "[bf.cfg Parameters](#)".

## **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
```

For more information and an example of the script that covers multiple DPU installation and configuration, refer to section "[Installing Full DOCA Image on Multiple DPUs](#)" of the *NVIDIA DOCA Installation Guide*.

## SoC Management Interface Features and Functionality

	Function	Command	Comments
1	Push BFB	<pre>bfb-install -r rshim&lt;N&gt; -b &lt;bfb&gt; [-c bf.cfg]</pre>	Using bf.cfg in the command is optional. For more details about bf.cfg, refer to section " <a href="#">DPU Configuration File</a> ".
2	Open console	<pre>screen /dev/rshim&lt;N&gt;/ console 115200 minicom -D /dev/rshim&lt;N&gt;/ console</pre>	The N index depends on the number of DPUs in your setup. Use Linux's screen or minicom console applications to access the BlueField console.
3	Configure a virtual network interface	<pre>ip addr add dev tmfifo_net&lt;N&gt; 192.168.100.1/3 0</pre>	The N index depends on the number of DPUs in your setup. Refer to section " <a href="#">SoC Management Interface Driver Support for Multiple DPUs</a> " for more information. The default IP address for the DPU is 192.168.100.2/30. The IP used in the command (192.168.100.1/30) is for example purposes only.
4	Log into the DPU	<pre>ssh -6 user@fe80::21a: caff:feff:ff01%tmfifo_net&lt;N&gt;</pre>	The N index depends on the number of DPUs in your setup. Refer to section " <a href="#">SoC Management Interface Driver Support for Multiple DPUs</a> " for more information.

	Function	Command	Comments
5	PXE boot over RShim	N/A	Please refer to section " <a href="#">Deploying BlueField Software Using BFB with PXE</a> " for more information.
6	Issue Arm software reset	<pre>echo "SW_RESET 1" &gt; /dev/rshim&lt;N&gt;/ misc</pre>	
7	Expose log messages	N/A	For more information, please refer to section " <a href="#">Logging</a> ".

## DPU Configuration File

The bf.cfg file contains configuration that can be pushed to customize the installation of the BFB.

Please see section "[bf.cfg Parameters](#)" for the bf.cfg file contents.

## BlueField OOB Ethernet Interface

The BlueField 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 using 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 BlueField boot stream. Any attempt to push a BFB to this port would not work. Refer to

["How to use the UEFI boot menu"](#) for more information about UEFI operations related to the OOB interface.

## 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.:



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, please refer to section "[Default Network Interface Configuration](#)".

---

# BlueField Operation

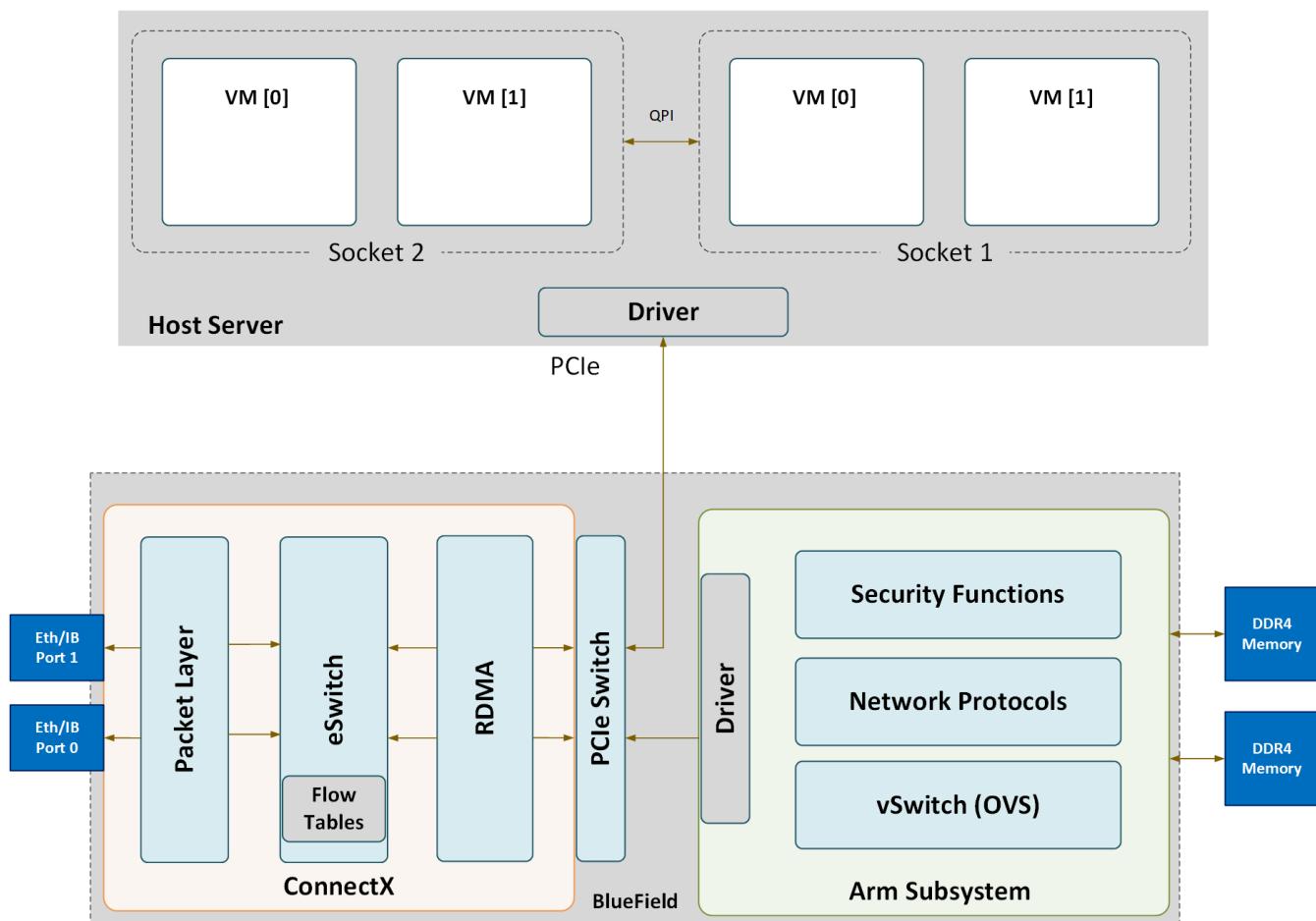
The NVIDIA® BlueField® [networking platform family](#) delivers the flexibility to accelerate a range of applications while leveraging ConnectX-based network controllers hardware-based offloads with unmatched scalability, performance, and efficiency.

- [Functional Diagram](#)
- [Modes of Operation](#)
- [Kernel Representors Model](#)
- [Multi-Host](#)
- [Virtual Switch on DPU](#)
- [Configuring Uplink MTU](#)
- [Link Aggregation](#)
- [Scalable Functions](#)
- [RDMA Stack Support on Host and Arm System](#)
- [Controlling Host PF and VF Parameters](#)
- [DPDK on BlueField DPU](#)
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- fTPM over OP-TEE
- QoS Configuration
- Virtio-net Emulated Devices
- Shared RQ Mode

## Functional Diagram

The following is a functional diagram of the NVIDIA® BlueField®-2 DPU.



For each BlueField DPU network port, there are 2 physical PCIe networking functions exposed:

- To the embedded Arm subsystem
- To the host over PCIe

### Note

Different functions have different default grace period values during which functions can recover from/handle a single fatal error:

- ECPFs have a graceful period of 3 minutes
- PFs have a graceful period of 1 minute
- VFs/SFs have a graceful period of 30 seconds

The mlx5 drivers and their corresponding software stacks must be loaded on both hosts (Arm and the host server). The OS running on each one of the hosts would probe the drivers. BlueField-2 network interfaces are compatible with NVIDIA® ConnectX®-6 and higher. BlueField-3 network interfaces are compatible with ConnectX-7 and higher.

The same network drivers are used both for BlueField and the ConnectX NIC family.

## Modes of Operation

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

- DPU mode, or embedded function (ECPF) ownership, where the embedded Arm system controls the NIC resources and data path
- Zero-trust 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

### Note

The default mode of operation for BlueField DPU is DPU mode

The default mode of operation for BlueField SuperNIC is NIC mode

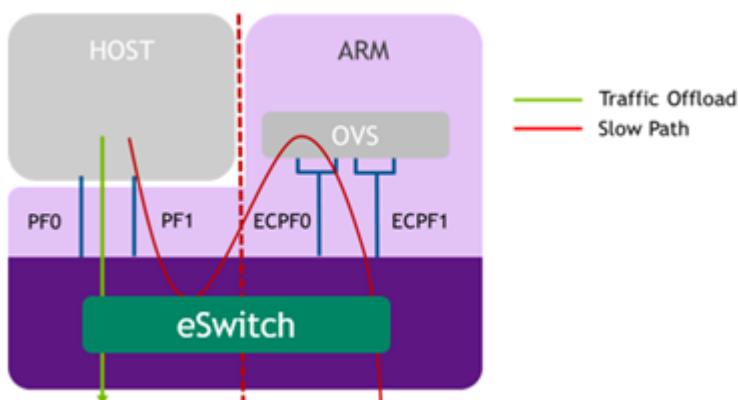
## DPU Mode

This mode, known also as embedded CPU function ownership (ECPF) mode, is the default mode for 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 DPU has loaded and completed NIC configuration.
2. All ICM (Interface Configuration Memory) is allocated by the ECPF and resides in the DPU's memory.
3. The ECPF controls and configures the NIC embedded switch which means that traffic to and from the host (DPU) 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.

In DPU mode, OpenSM must be run from the DPU side (not the host side). Also, management tools (e.g., sminfo, ibdev2netdev, ibnetdiscover) can only be run from the DPU side (not from the host side).

## Zero-trust 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 through 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

## Enabling Zero-trust Mode

To enable host restriction:

1. Start the MST service.
2. Set zero-trust mode. From the Arm side, run:

```
$ sudo mlxprivhost -d /dev/mst/<device> r --disable_rshim --disable_tracer --  
 disable_counter_rd --disable_port_owner
```

 **Note**

If any --disable\_\* flags are used, users must perform BlueField system-level reset as explained in the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page.

## Disabling Zero-trust Mode

To disable host restriction, set the mode to privileged. Run:

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

The configuration takes effect immediately.

 **Note**

If host restriction has been applied using any --disable\_\* flags, users must perform BlueField system-level reset as explained in the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page.

## NIC Mode

In this mode, the DPU behaves exactly like an adapter card from the perspective of the external host.

### **Note**

The following instructions presume the DPU to operate in DPU mode.  
If the DPU is operating in zero-trust mode, please [return to DPU mode](#) before continuing.

### **Note**

The following notes are relevant for updating the BFB Bundle in NIC mode:

- During BFB Bundle installation, Linux is expected to boot to upgrade NIC firmware and BMC software
- During the BFB Bundle installation, it is expected for the mlx5 driver to error messages on the x86 host. These prints may be ignored as they are resolved by a mandatory, post-installation power cycle.
- It is mandatory to power cycle the host after the installation is complete for the changes to take effect
- As Linux is booting during BFB Bundle installation, it is expected for the mlx5 core driver to timeout on the BlueField Arm

## **NIC Mode for BlueField-3**

### **Note**

When BlueField-3 is configured to operate in NIC mode, Arm OS will not boot.

NIC mode for BlueField-3 saves power, improves device performance, and improves the host memory footprint.

## Configuring NIC Mode on BlueField-3 from Linux

### Enabling NIC Mode on BlueField-3 from Linux

Before moving to NIC mode, make sure you are operating in DPU mode by running:

```
host/dpu> sudo mlxconfig -d /dev/mst/mt41692_pciconf0 -e q
```

The output should have INTERNAL\_CPU\_MODEL= EMBEDDED\_CPU(1) and EXP\_ROM\_UEFI\_ARM\_ENABLE = True (1) (default).

To enable NIC mode from DPU mode:

1. Run the following on the host or Arm:

```
host/dpu> sudo mlxconfig -d /dev/mst/mt41692_pciconf0 s  
INTERNAL_CPU_OFFLOAD_ENGINE=1
```

2. Perform a BlueField system-level reset, for the mlxconfig settings to take effect. Refer to the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page for instructions.

### Disabling NIC Mode on BlueField-3 from Linux

To return to DPU mode from NIC mode:

1. Run the following on the host:

```
host> sudo mlxconfig -d /dev/mst/mt41692_pciconf0 s  
INTERNAL_CPU_OFFLOAD_ENGINE=0
```

2. Perform a BlueField system-level reset for the mlxconfig settings to take effect. Refer to the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page for instructions.

## Configuring NIC Mode on BlueField-3 from Host BIOS HII UEFI Menu

 **Info**

The screenshots in this section are examples only and may vary depending on the vendor of your specific host.

1. Select the network device that presents the uplink (i.e., select the device with the uplink MAC address).
2. Select "BlueField Internal Cpu Configuration".

## Main Configuration Page

- ▶ Firmware Image Properties
- ▶ NIC Configuration
- ▶ iSCSI Configuration
- ▶ Power Configuration
- ▶ Device Level Configuration
- ▶ **BlueField Internal Cpu Configuration**

BlueField Internal  
Cpu Configuration

VMware Distributed	<Disabled>
Services Engine (DPU)	
Blink LEDs	[0]
Device Name	Nvidia Network Adapter
Chip Type	BlueField-3
PCI Device ID	A2DC
PCI Address	00:03:00
Link Status	<Connected>
Link Speed	<100Gbps>



- To enable NIC mode, set "Internal Cpu Offload Engine" to "Disabled".
- To switch back to DPU mode, set "Internal Cpu Offload Engine" to "Enabled".

## BlueField Internal Cpu Configuration

Internal Cpu Model	<EMBEDDED CPU>
Internal Cpu Page Supplier	<ECPF>
Internal Cpu Eswitch Manager	<ECPF>
Internal Cpu IB Uport0	<ECPF>
Internal Cpu Offload Engine	<Disabled>

Defines whether the Internal CPU is used as an offload engine

## Configuring NIC Mode on BlueField-3 from Arm UEFI

1. Access the Arm UEFI menu by pressing the Esc button twice.
2. Select "Device Manager".
3. Select "System Configuration".
4. Select "BlueField Modes".
5. Set the "NIC Mode" field to NicMode to enable NIC mode.

Internal CPU Model	<Embedded>	Enable/Disable NIC Mode. Any change to this value requires powercycling the system.
Host Privilege Level	<Privileged>	
NIC Mode	<NicMode>	
	0000000000000000L	
	? DpuMode      ?	
	? NicMode      ?	
	? Unavailable    ?	
	0000000000000000I	

### Info

Configuring Unavailable is inapplicable.

6. Exit "BlueField Modes" and "System Configuration" and make sure to save the settings. Exit the UEFI setup using the 'reset' option. The configuration is not yet applied and the DPU is expected to boot regularly, still in DPU Mode.
7. Perform a BlueField system-level reset, to change to NIC Mode. Refer to the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page for instructions.

## Configuring NIC Mode on BlueField-3 Using Redfish

Run the following from the BlueField BMC:

1. Get the current BIOS attributes:

```
sudo curl -k -u root:'<password>' -H 'content-type: application/json' -X GET  
https://<bmc_ip>/redfish/v1/Systems/Bluefield/Bios
```

2. Change BlueField mode from DpuMode to NicMode:

```
curl -k -u root:'<password>' -H 'content-type: application/json' -d '{ "Attributes":  
{ "NicMode": "NicMode" } }' -X PATCH  
https://<bmc_ip>/redfish/v1/Systems/Bluefield/Bios/Settings
```

 **Info**

To revert back to DPU mode, run:

```
curl -k -u root:'<password>' -H 'content-type:  
application/json' -d '{ "Attributes": { "NicMode":  
"DpuMode" } }' -X PATCH  
https://<bmc_ip>/redfish/v1/Systems/Bluefield/Bios/Settings
```

3. Verify that the BMC has registered the new settings:

```
curl -k -u root:'<password>' -H 'content-type: application/json' -X GET  
https://<bmc_ip>/redfish/v1/Systems/Bluefield/Bios/Settings
```

4. Issue a software reset then power cycle the host for the change to take effect.

5. Verify the mode is changed:

```
curl -k -u root:'<password>' -H 'content-type: application/json' -X GET  
https://<bmc_ip>/redfish/v1/Systems/Bluefield/Oem/Nvidia
```

### Note

To retrieve the mode via BIOS attributes, another BlueField software reset is required before running the command:

```
curl -k -u root:<password> -H 'content-type: application/json' -X  
GET https://<bmc_ip>/redfish/v1/Systems/Bluefield/Bios
```

## Updating Firmware Components in BlueField-3 NIC Mode

Once in NIC mode, updating ATF and UFEI can be done using the standard \*.bfm image:

```
# bfb-install --bfm <BlueField-BSP>.bfm --rshim rshim0
```

## NIC Mode for BlueField-2

In this mode, the ECPFs on the Arm side are not functional but the user is still able to access the Arm system and update mlxconfig options.

### Note

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

## Configuring NIC Mode on BlueField-2 from Linux

### Enabling NIC Mode on BlueField-2 from Linux

To enable NIC mode from DPU mode:

1. Run the following from the x86 host side:

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

 **Note**

To restrict RShim PF (optional), make sure to configure INTERNAL\_CPU\_RSHIM=1 as part of the `mlxconfig` command.

2. Perform BlueField system-level reset to load the new configuration .

 **Info**

Refer to the troubleshooting section of the guide for a step-by-step procedure.

 **Note**

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

 **Note**

To obtain firmware BINs for BlueField-2 devices, please refer to the [BlueField-2 firmware download page](#).

## Disabling NIC Mode on BlueField-2 from Linux

To change from NIC mode back to DPU 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_PAGE_SUPPLIER=0 \
INTERNAL_CPU_ESWITCH_MANAGER=0 \
INTERNAL_CPU_IB_VPORT0=0 \
INTERNAL_CPU_OFFLOAD_ENGINE=0
```

 **Note**

If INTERNAL\_CPU\_RSHIM=1, then make sure to configure INTERNAL\_CPU\_RSHIM=0 as part of the mlxconfig command.

3. Perform a BlueField system reboot for the mlxconfig settings to take effect. Refer to the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page for instructions.

## Configuring NIC Mode on BlueField-2 from Arm UEFI

Follow the same instructions in section "[Configuring NIC Mode on BlueField-3 from Arm UEFI](#)".

## Configuring NIC Mode on BlueField-2 Using Redfish

Follow the same instructions in section "[Configuring NIC Mode on BlueField-3 Using Redfish](#)".

# Kernel Representors Model

### Note

This model is only applicable when the DPU is operating in [DPU mode](#).

BlueField® DPU uses netdev representors to map each one of the host side physical and virtual functions.

1. Serve as the tunnel to pass traffic for the virtual switch or application running on the Arm cores to the relevant PF or VF on the host side.
2. Serve as the channel to configure the embedded switch with rules to the corresponding represented function.

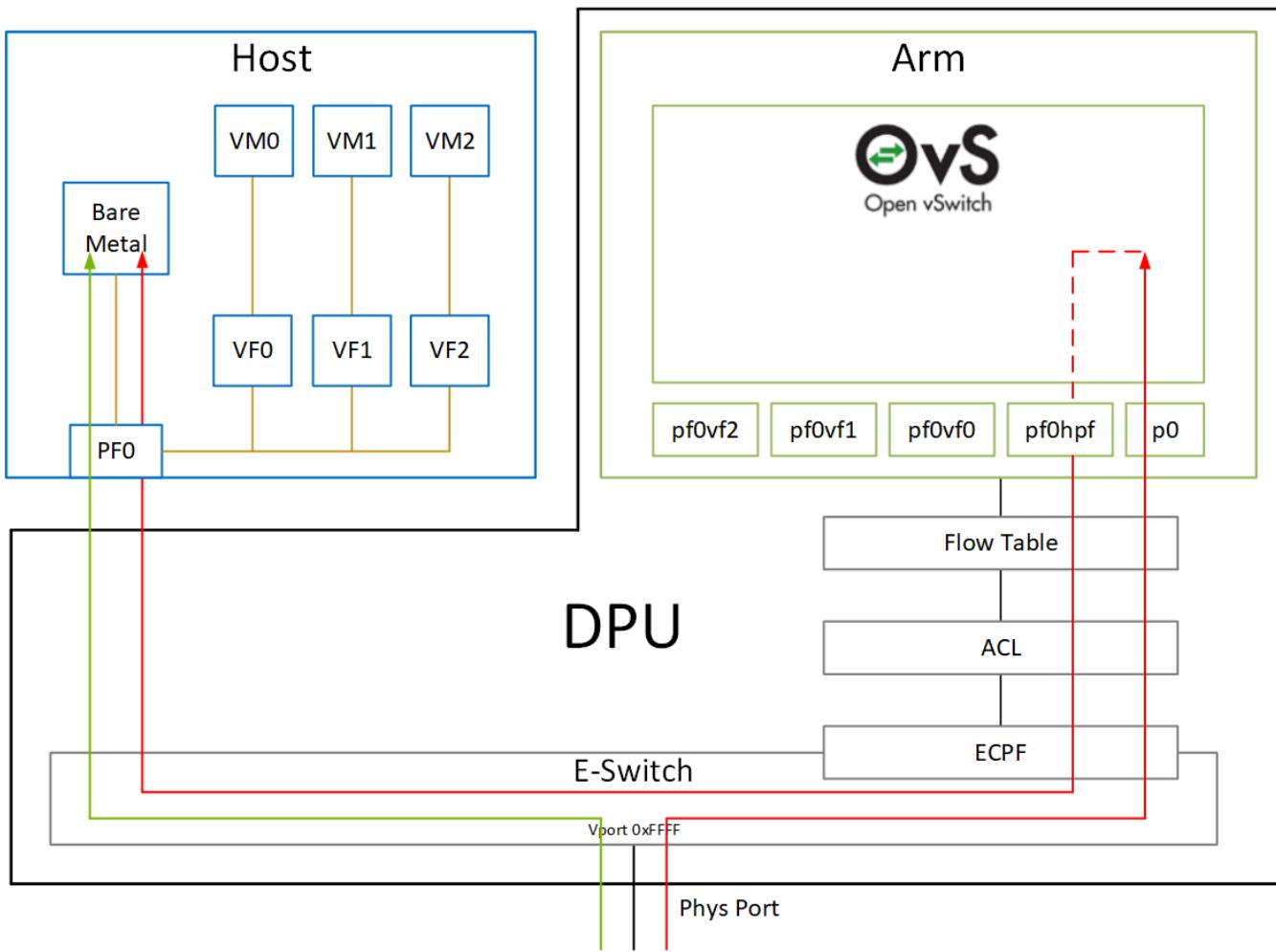
Those representors are used as the virtual ports being connected to OVS or any other virtual switch running on the Arm cores.

When operating in [DPU mode](#), we see 2 representors for each one of the DPU's network ports: one for the uplink, and another one for the host side PF (the PF representor created even if the PF is not probed on the host side). For each one of the VFs created on

the host side a corresponding representor would be created on the Arm side. The naming convention for the representors is as follows:

- Uplink representors: p<port\_number>
- PF representors: pf<port\_number>hpf
- VF representors: pf<port\_number>vf<function\_number>

The following diagram shows the mapping of between the PCIe functions exposed on the host side and the representors. For the sake of simplicity, a single port model (duplicated for the second port) is shown.



The red arrow demonstrates a packet flow through the representors, while the green arrow demonstrates the packet flow when steering rules are offloaded to the embedded switch. More details on that are available in the switch offload section.

### **Note**

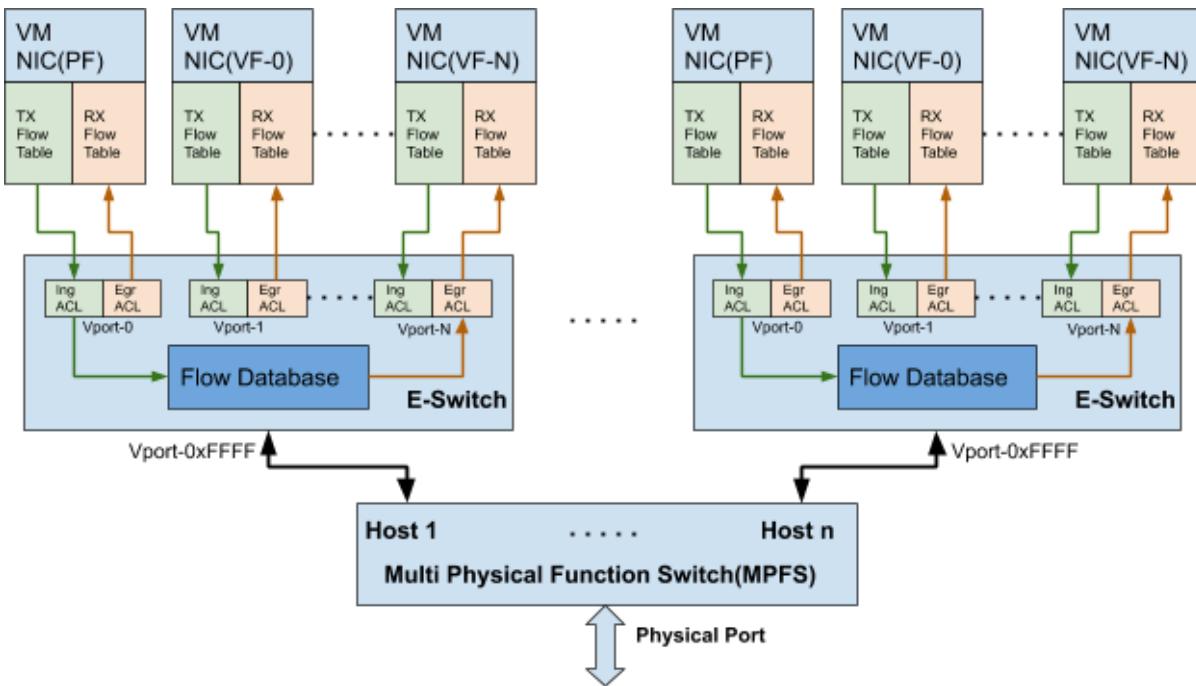
The MTU of host functions (PF/VF) must be smaller than the MTUs of both the uplink and corresponding PF/VF representor. For example, if the host PF MTU is set to 9000, both uplink and PF representor must be set to above 9000.

## Multi-Host

### **Note**

This is only applicable to DPUs running on multi-host model.

In multi-host mode, each host interface can be divided into up to 4 independent PCIe interfaces. All interfaces would share the same physical port, and are managed by the same multi-physical function switch (MPFS). Each host would have its own e-switch and would control its own traffic.



## Representors

Similar to [Kernel Representors Model](#), each host here has an uplink representor, PF representor, and VF representors (if SR-IOV is enabled). There are 8 sets of representors (uplink/PF; see example code). For each host to work with OVS offload, the corresponding representors must be added to the OVS bridge.

```

139: p0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq master ovs-
system state UP group default qlen 1000
link/ether 0c:42:a1:70:1d:b2 brd ff:ff:ff:ff:ff:ff
140: p1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000
link/ether 0c:42:a1:70:1d:b3 brd ff:ff:ff:ff:ff:ff
141: p2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq master ovs-
system state UP group default qlen 1000
link/ether 0c:42:a1:70:1d:b4 brd ff:ff:ff:ff:ff:ff
142: p3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000
link/ether 0c:42:a1:70:1d:b5 brd ff:ff:ff:ff:ff:ff
143: p4: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000

```

```
link/ether 0c:42:a1:70:1d:b6 brd ff:ff:ff:ff:ff:ff
144: p5: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000
link/ether 0c:42:a1:70:1d:b7 brd ff:ff:ff:ff:ff:ff
145: p6: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000
link/ether 0c:42:a1:70:1d:b8 brd ff:ff:ff:ff:ff:ff
146: p7: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000
link/ether 0c:42:a1:70:1d:b9 brd ff:ff:ff:ff:ff:ff
147: pf0hpf: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq master
ovs-system state UP group default qlen 1000
link/ether 86:c5:8a:b7:7c:84 brd ff:ff:ff:ff:ff:ff
148: pf1hpf: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000
link/ether 6e:ea:1b:84:88:49 brd ff:ff:ff:ff:ff:ff
149: pf2hpf: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000
link/ether 92:ec:99:cb:d7:23 brd ff:ff:ff:ff:ff:ff
150: pf3hpf: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000
link/ether 0e:0d:8e:03:2e:27 brd ff:ff:ff:ff:ff:ff
151: pf4hpf: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000
link/ether 5e:42:af:05:67:93 brd ff:ff:ff:ff:ff:ff
152: pf5hpf: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000
link/ether 96:e4:69:4c:b7:7f brd ff:ff:ff:ff:ff:ff
153: pf6hpf: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000
link/ether 5e:67:33:c0:35:05 brd ff:ff:ff:ff:ff:ff
154: pf7hpf: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP
group default qlen 1000
link/ether 12:29:7d:56:07:3e brd ff:ff:ff:ff:ff:ff
```

The following is an example of adding all representors to OVS:

Bridge armBr-3

Port armBr-3

Interface armBr-3

type: internal

Port p3

Interface p3

Port pf3hpf

Interface pf3hpf

Bridge armBr-2

Port p2

Interface p2

Port pf2hpf

Interface pf2hpf

Port armBr-2

Interface armBr-2

type: internal

Bridge armBr-5

Port p5

Interface p5

Port pf5hpf

Interface pf5hpf

Port armBr-5

Interface armBr-5

type: internal

Bridge armBr-7

Port pf7hpf

Interface pf7hpf

Port armBr-7

Interface armBr-7

type: internal

Port p7

Interface p7

Bridge armBr-0

Port p0

Interface p0

```
Port armBr-0
Interface armBr-0
type: internal
Port pf0hpf
Interface pf0hpf
Bridge armBr-4
Port p4
Interface p4
Port pf4hpf
Interface pf4hpf
Port armBr-4
Interface armBr-4
type: internal
Bridge armBr-1
Port armBr-1
Interface armBr-1
type: internal
Port p1
Interface p1
Port pf1hpf
Interface pf1hpf
Bridge armBr-6
Port armBr-6
Interface armBr-6
type: internal
Port p6
Interface p6
Port pf6hpf
Interface pf6hpf
ovs_version: "2.13.1"
```

For now, users can get the representor-to-host PF mapping by comparing the MAC address queried from host control on the Arm-side and PF MAC on the host-side. In the following example, the user knows p0 is the uplink representor for p6p1 as the MAC address is the same.

From Arm:

```
# cat /sys/class/net/p0/smart_nic/pf/config  
MAC : 0c:42:a1:70:1d:9a  
MaxTxRate : 0  
State : Up
```

From host:

```
# ip addr show p6p1  
3: p6p1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP  
group default qlen 1000  
link/ether 0c:42:a1:70:1d:9a brd ff:ff:ff:ff:ff:ff
```

The implicit mapping is as follows:

- PF0, PF1 = host controller 1
- PF2, PF3 = host controller 2
- PF4, PF5 = host controller 3
- PF6, PF7 = host controller 4

**(i) Note**

The maximum SF or VF count across all hosts is limited to 488 in total.  
The user can divide 488 VFs/SFs to single or multiple controllers as desired.

## Virtual Switch on DPU

**(i) Note**

For general information on OVS offload using ASAP<sup>2</sup> direct, please refer to the [MLNX\\_OFED documentation](#) under OVS Offload Using ASAP<sup>2</sup> Direct.

**(i) Note**

ASAP<sup>2</sup> is only supported in Embedded (DPU) mode.

NVIDIA® BlueField® supports [ASAP<sup>2</sup> technology](#). It utilizes the representors mentioned in the previous section. BlueField SW package includes OVS installation which already supports ASAP<sup>2</sup>. The virtual switch running on the Arm cores allows us to pass all the traffic to and from the host functions through the Arm cores while performing all the operations supported by OVS. ASAP<sup>2</sup> allows us to offload the datapath by programming the NIC embedded switch and avoiding the need to pass every packet through the Arm cores. The control plane remains the same as working with standard OVS.

OVS bridges are created by default upon first boot of the DPU after BFB installation.

If manual configuration of the default settings for the OVS bridge is desired, run:

```
systemctl start openvswitch-switch.service  
ovs-vsctl add-port ovsbr1 p0  
ovs-vsctl add-port ovsbr1 pf0hpf  
ovs-vsctl add-port ovsbr2 p1  
ovs-vsctl add-port ovsbr2 pf1hpf
```

To verify successful bridging:

```
$ ovs-vsctl show
```

```
9f635bd1-a9fd-4f30-9bdc-b3fa21f8940a
Bridge ovsbr2
Port ovsbr2
Interface ovsbr2
type: internal
Port p1
Interface p1
Port pf1sf0
Interface en3f1pf1sf0
    Port pf1hpf
Interface pf1hpf
Bridge ovsbr1
Port pf0hpf
Interface pf0hpf
Port p0
Interface p0
Port ovsbr1
Interface ovsbr1
type: internal
Port pf0sf0
Interface en3f0pf0sf0
ovs_version: "2.14.1"
```

The host is now connected to the network.

### Note

TC-offload is not supported for IPv6 fragment packets. To make IPv6 fragment packets pass through OVS, the MTU of a specific port must be set to equal to or larger than the fragmented packet size. IPv4 fragment packets can be TC-offloaded as their packet size is not checked by OVS.

## Verifying Host Connection on Linux

When the DPU is connected to another DPU on another machine, manually assign IP addresses with the same subnet to both ends of the connection.

1. Assuming the link is connected to p3p1 on the other host, run:

```
$ ifconfig p3p1 192.168.200.1/24 up
```

2. On the host which the DPU is connected to, run:

```
$ ifconfig p4p2 192.168.200.2/24 up
```

3. Have one ping the other. This is an example of the DPU pinging the host:

```
$ ping 192.168.200.1
```

## Verifying Connection from Host to BlueField

There are two SFs configured on the BlueField-2 device, enp3s0f0s0 and enp3s0f1s0, and their representors are part of the built-in bridge. These interfaces will get IP addresses from the DHCP server if it is present. Otherwise it is possible to configure IP address from the host. It is possible to access BlueField via the SF netdev interfaces.

For example:

1. Verify the default OVS configuration. Run:

```
# ovs-vsctl show
5668f9a6-6b93-49cf-a72a-14fd64b4c82b
Bridge ovsbr1
Port pf0hpf
Interface pf0hpf
Port ovsbr1
Interface ovsbr1
type: internal
```

```
Port p0
Interface p0
Port en3f0pf0sf0
    Interface en3f0pf0sf0
Bridge ovsbr2
Port en3f1pf1sf0
Interface en3f1pf1sf0
Port ovsbr2
Interface ovsbr2
type: internal
Port pf1hp1
Interface pf1hp1
Port p1
Interface p1
ovs_version: "2.14.1"
```

2. Verify whether the SF netdev received an IP address from the DHCP server. If not, assign a static IP. Run:

```
# ifconfig enp3s0f0s0
enp3s0f0s0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
inet 192.168.200.125 netmask 255.255.255.0 broadcast 192.168.200.255
inet6 fe80::8e:bcff:fe36:19bc prefixlen 64 scopeid 0x20<link>
ether 02:8e:bc:36:19:bc txqueuelen 1000 (Ethernet)
RX packets 3730 bytes 1217558 (1.1 MiB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 22 bytes 2220 (2.1 KiB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

3. Verify the connection of the configured IP address. Run:

```
# ping 192.168.200.25 -c 5
PING 192.168.200.25 (192.168.200.25) 56(84) bytes of data.
64 bytes from 192.168.200.25: icmp_seq=1 ttl=64 time=0.228 ms
64 bytes from 192.168.200.25: icmp_seq=2 ttl=64 time=0.175 ms
```

```
64 bytes from 192.168.200.25: icmp_seq=3 ttl=64 time=0.232 ms
64 bytes from 192.168.200.25: icmp_seq=4 ttl=64 time=0.174 ms
64 bytes from 192.168.200.25: icmp_seq=5 ttl=64 time=0.168 ms

--- 192.168.200.25 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 91ms
rtt min/avg/max/mdev = 0.168/0.195/0.232/0.031 ms
```

## Verifying Host Connection on Windows

Set IP address on the Windows side for the RShim or Physical network adapter, please run the following command in Command Prompt:

```
PS C:\Users\Administrator> New-NetIPAddress -InterfaceAlias "Ethernet 16" -
IPAddress "192.168.100.1" -PrefixLength 22
```

To get the interface name, please run the following command in Command Prompt:

```
PS C:\Users\Administrator> Get-NetAdapter
```

Output should give us the interface name that matches the description (e.g. NVIDIA BlueField Management Network Adapter).

```
Ethernet 2 NVIDIA ConnectX-4 Lx Ethernet Adapter 6 Not Present 24-8A-07-0D-E8-
1D
Ethernet 6 NVIDIA ConnectX-4 Lx Ethernet Ad...#2 23 Not Present 24-8A-07-0D-E8-
1C
Ethernet 16 NVIDIA BlueField Management Netw...#2 15 Up CA-FE-01-CA-FE-02
```

Once IP address is set, Have one ping the other.

```
C:\Windows\system32>ping 192.168.100.2
```

```
Pinging 192.168.100.2 with 32 bytes of data:  
Reply from 192.168.100.2: bytes=32 time=148ms TTL=64  
Reply from 192.168.100.2: bytes=32 time=152ms TTL=64  
Reply from 192.168.100.2: bytes=32 time=158ms TTL=64  
Reply from 192.168.100.2: bytes=32 time=158ms TTL=64
```

## Enabling OVS HW Offloading

OVS HW offloading is set by default by the `/sbin/mlnx_bf_configure` script upon first boot after installation.

1. Enable TC offload on the relevant interfaces. Run:

```
$ ethtool -K <PF> hw-tc-offload on
```

2. Enable the HW offload: run the following commands (after enabling the HW offload):

```
$ ovs-vsctl set Open_vSwitch . Other_config:hw-offload=true
```

3. Restarting OVS is required for the configuration to apply:

- For Ubuntu:

```
$ systemctl restart openvswitch-<switch>
```

- For CentOS/RHEL:

```
$ systemctl restart openvswitch
```

To show OVS configuration:

```
$ ovs-dpctl show  
system@ovs-system:  
lookups: hit:0 missed:0 lost:0  
flows: 0
```

```
masks: hit:0 total:0 hit/pkt:0.00
port 0: ovs-system (internal)
port 1: armbr1 (internal)
port 2: p0
port 3: pf0hpf
port 4: pf0vf0
port 5: pf0vf1
port 6: pf0vf2
```

At this point OVS would automatically try to offload all the rules.

To see all the rules that are added to the OVS datapath:

```
$ ovs-appctl dpctl/dump-flows
```

To see the rules that are offloaded to the HW:

```
$ ovs-appctl dpctl/dump-flows type=offloaded
```

## Enabling OVS-DPDK Hardware Offload

1. Remove previously configured OVS bridges. Run:

```
ovs-vsctl del-br <bridge-name>
```

Issue the command `ovs-vsctl show` to see already configured OVS bridges.

2. Enable the Open vSwitch service. Run:

```
systemctl start openvswitch
```

3. Configure huge pages:

```
echo 1024 > /sys/kernel/mm/hugepages/hugepages-2048kB/nr_hugepages
```

4. Configure DPDK socket memory and limit. Run:

```
# ovs-vsctl set Open_vSwitch . other_config:dpdk-socket-limit=2048  
# ovs-vsctl set Open_vSwitch . other_config:dpdk-socket-mem=2048
```

5. Enable hardware offload (disabled by default). Run:

```
ovs-vsctl --no-wait set Open_vSwitch . other_config:dpdk-init=true  
ovs-vsctl --no-wait set Open_vSwitch . other_config:hw-offload=true
```

6. Configure the DPDK whitelist. Run:

```
ovs-vsctl set Open_vSwitch . other_config:dpdk-extra="-a  
0000:03:00.0,representer=  
[0,65535],dv_flow_en=1,dv_xmeta_en=1,sys_mem_en=1"
```

7. Create OVS-DPDK bridge. Run:

```
ovs-vsctl add-br br0-ovs -- set Bridge br0-ovs datapath_type=netdev -- br-set-  
external-id br0-ovs bridge-id br0-ovs -- set bridge br0-ovs fail-  
mode=standalone
```

8. Add PF to OVS. Run:

```
ovs-vsctl add-port br0-ovs p0 -- set Interface p0 type=dpdk options:dpdk-  
devargs=0000:03:00.0
```

9. Add representer to OVS. Run:

```
ovs-vsctl add-port br0-ovs pf0vf0 -- set Interface pf0vf0 type=dpdk  
options:dpdk-devargs=0000:03:00.0,representer=[0]  
ovs-vsctl add-port br0-ovs pf0hpf -- set Interface pf0hpf type=dpdk  
options:dpdk-devargs=0000:03:00.0,representer=[65535]
```

10. Restart the Open vSwitch service. This step is required for HW offload changes to take effect.

- For CentOS, run:

```
systemctl restart openvswitch
```

- For Debian/Ubuntu, run:

```
systemctl restart openvswitch-switch
```

For a reference setup configuration for BlueField-2 devices, refer to the article "[Configuring OVS-DPDK Offload with BlueField-2](#)".

## Configuring DPDK and Running TestPMD

1. Configure hugepages. Run:

```
echo 1024 > /sys/kernel/mm/hugepages/hugepages-2048kB/nr_hugepages
```

2. Run testpmd.

- For Ubuntu/Debian:

```
env LD_LIBRARY_PATH=/opt/mellanox/dpdk/lib/aarch64-linux-gnu  
/opt/mellanox/dpdk/bin/dpdk-testpmd -a 03:00.0,representor=[0,65535]  
--socket-mem=1024 -- --total-num-mbufs=131000 -i
```

- For CentOS:

```
env LD_LIBRARY_PATH=/opt/mellanox/dpdk/lib64/  
/opt/mellanox/dpdk/bin/dpdk-testpmd -a 03:00.0,representor=[0,65535]  
--socket-mem=1024 -- --total-num-mbufs=131000 -i
```

For a detailed procedure with port display, refer to the article "[Configuring DPDK and Running testpmd on BlueField-2](#)".

## Flow Statistics and Aging

The aging timeout of OVS is given in milliseconds and can be configured by running the following command:

```
$ ovs-vsctl set Open_vSwitch . other_config:max-idle=30000
```

## Connection Tracking Offload

This feature enables tracking connections and storing information about the state of these connections. When used with OVS, the DPU can offload connection tracking, so that traffic of established connections bypasses the kernel and goes directly to hardware.

Both source NAT (SNAT) and destination NAT (DNAT) are supported with connection tracking offload.

## Configuring Connection Tracking Offload

This section provides an example of configuring OVS to offload all IP connections of host PF0.

1. [Enable OVS HW offloading](#).
2. Create OVS connection tracking bridge. Run:

```
$ ovs-vsctl add-br ctBr
```

3. Add p0 and pf0hp to the bridge. Run:

```
$ ovs-vsctl add-port ctBr p0  
$ ovs-vsctl add-port ctBr pf0hp
```

4. Configure ARP packets to behave normally. Packets which do not comply are routed to table1. Run:

```
$ ovs-ofctl add-flow ctBr "table=0,arp,action=normal"  
$ ovs-ofctl add-flow ctBr "table=0,ip,ct_state=-trk,action=ct(table=1)"
```

5. Configure RoCEv2 packets to behave normally. RoCEv2 packets follow UDP port 4791 and a different source port in each direction of the connection. RoCE traffic is not supported by CT. In order to run RoCE from the host add the following line before ovs-ofctl add-flow ctBr "table=0,ip,ct\_state=-trk,action=ct(table=1)":

```
$ ovs-ofctl add-flow ctBr table=0,udp,tp_dst=4791,action=normal
```

This rule allows RoCEv2 UDP packets to skip connection tracking rules.

6. Configure the new established flows to be admitted to the connection tracking bridge and to then behave normally. Run:

```
$ ovs-ofctl add-flow ctBr  
"table=1,priority=1,ip,ct_state=+trk+new,action=ct(commit),normal"
```

7. Set already established flows to behave normally. Run:

```
$ ovs-ofctl add-flow ctBr  
"table=1,priority=1,ip,ct_state=+trk+est,action=normal"
```

## Connection Tracking With NAT

This section provides an example of configuring OVS to offload all IP connections of host PF0, and performing source network address translation (SNAT). The server host sends traffic via source IP from 2.2.2.1 to 1.1.1.2 on another host. Arm performs SNAT and changes the source IP to 1.1.1.16. Note that static ARP or route table must be configured to find that route.

1. Configure untracked IP packets to do nat. Run:

```
ovs-ofctl add-flow ctBr "table=0,ip,ct_state=-trk,action=ct(table=1,nat)"
```

2. Configure new established flows to do SNAT, and change source IP to 1.1.1.16. Run:

```
ovs-ofctl add-flow ctBr  
"table=1,in_port=pf0hpf,ip,ct_state==+trk+new,action=ct(commit,nat(src=1.1.1.16)  
p0"
```

3. Configure already established flows act normal. Run:

```
ovs-ofctl add-flow ctBr "table=1,ip,ct_state==+trk+est,action=normal"
```

Conntrack shows the connection with SNAT applied. Run `conntrack -L` for Ubuntu 22.04 kernel or `cat /proc/net/nf_conntrack` for older kernel versions. Example output:

```
ipv4 2 tcp 6 src=2.2.2.1 dst=1.1.1.2 sport=34541 dport=5001 src=1.1.1.2  
dst=1.1.1.16 sport=5001 dport=34541 [OFFLOAD] mark=0 zone=1 use=3
```

## Querying Connection Tracking Offload Status

Start traffic on PF0 from the server host (e.g., `iperf`) with an external network. Note that only established connections can be offloaded. TCP should have already finished the handshake, UDP should have gotten the reply.

### **Note**

ICMP is not currently supported.

To check if specific connections are offloaded from Arm, run `conntrack -L` for Ubuntu 22.04 kernel or `cat /proc/net/nf_conntrack` for older kernel versions.

The following is example output of offloaded TCP connection:

```
ipv4 2 tcp 6 src=1.1.1.2 dst=1.1.1.3 sport=51888 dport=5001 src=1.1.1.3 dst=1.1.1.2  
sport=5001 dport=51888 [HW_OFFLOAD] mark=0 zone=0 use=3
```

## Performance Tune Based on Traffic Pattern

Offloaded flows (including connection tracking) are added to virtual switch FDB flow tables. FDB tables have a set of flow groups. Each flow group saves the same traffic pattern flows. For example, for connection tracking offloaded flow, TCP and UDP are different traffic patterns which end up in two different flow groups.

A flow group has a limited size to save flow entries. By default, the driver has 4 big FDB flow groups. Each of these big flow groups can save at most  $4000000/(4+1)=800k$  different 5-tuple flow entries. For scenarios with more than 4 traffic patterns, the driver provides a module parameter (`num_of_groups`) to allow customization and performance tune.

### Note

The size of each big flow groups can be calculated according to formula:  $\text{size} = 4000000/(\text{num\_of\_groups}+1)$

To change the number of big FDB flow groups, run:

```
$ echo <num_of_groups> > /sys/module/mlx5_core/parameters/num_of_groups
```

The change takes effect immediately if there is no flow inside the FDB table (no traffic running and all offloaded flows are aged out), and it can be dynamically changed without reloading the driver.

If there are residual offloaded flows when changing this parameter, then the new configuration only takes effect after all flows age out.

## Connection Tracking Aging

Aside from the aging of OVS, connection tracking offload has its own aging mechanism with a default aging time of 30 seconds.

## Maximum Tracked Connections

### Note

The maximum number for tracked offloaded connections is limited to 1M by default.

The OS has a default setting of maximum tracked connections which may be configured by running:

```
$ /sbin/sysctl -w net.netfilter.nf_conntrack_max=1000000
```

This changes the maximum tracked connections (both offloaded and non-offloaded) setting to 1 million.

The following option specifies the limit on the number of offloaded connections. For example:

```
# devlink dev param set pci/${pci_dev} name ct_max_offloaded_conns value $max  
cmode runtime
```

This value is set to 1 million by default from BlueFiled. Users may choose a different number by using the devlink command.

## Note

Make sure `net.netfilter.nf_conntrack_tcp_be Liberal=1` when using connection tracking.

## Offloading VLANs

OVS enables VF traffic to be tagged by the virtual switch.

For the BlueField DPU, the OVS can add VLAN tag (VLAN push) to all the packets sent by a network interface running on the host (either PF or VF) and strip the VLAN tag (VLAN pop) from the traffic going from the wire to that interface. Here we operate in Virtual Switch Tagging (VST) mode. This means that the host/VM interface is unaware of the VLAN tagging. Those rules can also be offloaded to the HW embedded switch.

To configure OVS to push/pop VLAN you need to add the `tag=$TAG` section for the OVS command line that adds the representor ports. So if you want to tag all the traffic of VF0 with VLAN ID 52, you should use the following command when adding its representor to the bridge:

```
$ ovs-vsctl add-port armbr1 pf0vf0 tag=52
```

## Note

If the virtual port is already connected to the bridge prior to configuring VLAN, you would need to remove it first:

```
$ ovs-vsctl del-port pf0vf0
```

In this scenario all the traffic being sent by VF 0 will have the same VLAN tag. We could set a VLAN tag by flow when using the TC interface, this is explained in section "[Using TC Interface to Configure Offload Rules](#)".

## VXLAN Tunneling Offload

VXLAN tunnels are created on the Arm side and attached to the OVS. VXLAN decapsulation/encapsulation behavior is similar to normal VXLAN behavior, including over `hw_offload=true`.

To allow VXLAN encapsulation, the uplink representor (`p0`) should have an MTU value at least 50 bytes greater than that of the host PF/VF. Please refer to "[Configuring Uplink MTU](#)" for more information.

## Configuring VXLAN Tunnel

1. Consider `p0` to be the local VXLAN tunnel interface (or VTEP).

 **Note**

To be consistent with the examples below, it is assumed that `p0` is configured with a 1.1.1.1 IPv4 address.

2. Remove `p0` from any OVS bridge.
3. Build a VXLAN tunnel over OVS arm-ovs. Run:

```
ovs-vsctl add-br arm-ovs -- add-port arm-ovs vxlan11 -- set interface vxlan11
type=vxlan
options:local_ip=1.1.1.1 options:remote_ip=1.1.1.2 options:key=100
options:dst_port=4789
```

4. Connect any host representor (e.g., `pf0hpf`) for which VXLAN is desired to the same arm-ovs bridge.

5. Configure the MTU of the VTEP (p0) used by VXLAN to at least 50 bytes larger than the host representor's MTU.

At this point, the host is unaware of any VXLAN operations done by the DPU's OVS. If the remote end of the VXLAN tunnel is properly set, any network traffic traversing arm-ovs undergoes VXLAN encap/decap.

## Querying OVS VXLAN hw\_offload Rules

Run the following:

```
ovs-appctl dpctl/dump-flows type=offloaded
in_port(2),eth(src=ae:fd:f3:31:7e:7b, dst=a2:fb:09:85:84:48), eth_type(0x0800),
packets:1, bytes:98, used:0.900s,
actions:set(tunnel(tun_id=0x64,src=1.1.1.1,dst=1.1.1.2,tp_dst=4789,flags(key))),3
tunnel(tun_id=0x64,src=1.1.1.2,dst=1.1.1.1,tp_dst=4789,flags(+key)),in_port(3),eth(src=
packets:75, bytes:7350, used:0.900s, actions:2
```

### Note

For the host PF, in order for VXLAN to work properly with the default 1500 MTU, follow these steps.

1. Disable host PF as the port owner from Arm (see section "[Zero-trust Mode](#)"). Run:

```
$ mlxprivhost -d /dev/mst/mt41682_pciconf0 --
 disable_port_owner r
```

2. The MTU of the end points (pf0hpf in the example above) of the VXLAN tunnel must be smaller than the MTU of the tunnel

interfaces (p0) to account for the size of the VXLAN headers. For example, you can set the MTU of P0 to 2000.

## GRE Tunneling Offload

GRE tunnels are created on the Arm side and attached to the OVS. GRE decapsulation/encapsulation behavior is similar to normal GRE behavior, including over hw\_offload=true.

To allow GRE encapsulation, the uplink representor (p0) should have an MTU value at least 50 bytes greater than that of the host PF/VF.

Please refer to "[Configuring Uplink MTU](#)" for more information.

## Configuring GRE Tunnel

1. Consider p0 to be the local GRE tunnel interface. p0 should not be attached to any OVS bridge.

### Note

To be consistent with the examples below, it is assumed that p0 is configured with a 1.1.1.1 IPv4 address and that the remote end of the tunnel is 1.1.1.2.

2. Create an OVS bridge, br0, with a GRE tunnel interface, gre0. Run:

```
ovs-vsctl add-port br0 gre0 -- set interface gre0 type=gre  
options:local_ip=1.1.1.1 options:remote_ip=1.1.1.2 options:key=100
```

3. Add pf0hpf to br0.

```
ovs-vsctl add-port br0 pf0hpf
```

4. At this point, any network traffic sent or received by the host's PF0 undergoes GRE processing inside the BlueField OS.

## Querying OVS GRE hw\_offload Rules

Run the following:

```
ovs-appctl dptcl/dump-flows type=offloaded
recirc_id(0),in_port(3),eth(src=50:6b:4b:2f:0b:74, dst=de:d0:a3:63:0b:30),eth_type(0x0800)
packets:878, bytes:122802, used:0.440s,
actions:set(tunnel(tun_id=0x64,src=1.1.1.1, dst=1.1.1.2,ttl=64,flags(key))),2
tunnel(tun_id=0x64,src=1.1.1.1, dst=1.1.1.2,flags(+key)),recirc_id(0),in_port(2),eth(src=d0:a3:63:0b:30:00)
packets:995, bytes:97510, used:0.440s, actions:3
```

### Note

For the host PF, in order for GRE to work properly with the default 1500 MTU, follow these steps.

1. Disable host PF as the port owner from Arm (see section "[Zero-trust Mode](#)"). Run:

```
$ mlxprivhost -d /dev/mst/mt41682_pciconf0 --
 disable_port_owner r
```

2. The MTU of the end points (pf0hpf in the example above) of the GRE tunnel must be smaller than the MTU of the tunnel interfaces (p0) to account for the size of the GRE headers. For example, you can set the MTU of P0 to 2000.

## GENEVE Tunneling Offload

GENEVE tunnels are created on the Arm side and attached to the OVS. GENEVE decapsulation/encapsulation behavior is similar to normal GENEVE behavior, including over hw\_offload=true.

To allow GENEVE encapsulation, the uplink representor (p0) must have an MTU value at least 50 bytes greater than that of the host PF/VF.

Please refer to "[Configuring Uplink MTU](#)" for more information.

## Configuring GENEVE Tunnel

1. Consider p0 to be the local GENEVE tunnel interface. p0 should not be attached to any OVS bridge.
2. Create an OVS bridge, br0, with a GENEVE tunnel interface, gnv0. Run:

```
ovs-vsctl add-port br0 gnv0 -- set interface gnv0 type=geneve  
options:local_ip=1.1.1.1 options:remote_ip=1.1.1.2 options:key=100
```

3. Add pf0hp to br0.

```
ovs-vsctl add-port br0 pf0hp
```

4. At this point, any network traffic sent or received by the host's PF0 undergoes GENEVE processing inside the BlueField OS.

Options are supported for GENEVE. For example, you may add option 0xea55 to tunnel metadata, run:

```
ovs-ofctl add-tlv-map geneve_br "{class=0xffff,type=0x0,len=4}->tun_metadata0"  
ovs-ofctl add-flow geneve_br ip,actions="set_field:0xea55->tun_metadata0",normal
```

## Note

For the host PF, in order for GENEVE to work properly with the default 1500 MTU, follow these steps.

1. Disable host PF as the port owner from Arm (see section "[Zero-trust Mode](#)"). Run:

```
$ mlxprivhost -d /dev/mst/mt41682_pciconf0 --  
    disable_port_owner r
```

2. The MTU of the end points (pf0hpf in the example above) of the GENEVE tunnel must be smaller than the MTU of the tunnel interfaces (p0) to account for the size of the GENEVE headers. For example, you can set the MTU of P0 to 2000.

## Using TC Interface to Configure Offload Rules

Offloading rules can also be added directly, and not just through OVS, using the tc utility. To enable TC ingress on all the representors (i.e., uplink, PF, and VF).

```
$ tc qdisc add dev p0 ingress  
$ tc qdisc add dev pf0hpf ingress  
$ tc qdisc add dev pf0vf0 ingress
```

## L2 Rules Example

The rule below drops all packets matching the given source and destination MAC addresses.

```
$ tc filter add dev pf0hpf protocol ip parent ffff: \  
    flower \
```

```
skip_sw \
dst_mac e4:11:22:11:4a:51 \
src_mac e4:11:22:11:4a:50 \
action drop
```

## VLAN Rules Example

The following rules push VLAN ID 100 to packets sent from VF0 to the wire (and forward it through the uplink representor) and strip the VLAN when sending the packet to the VF.

```
$ tc filter add dev pf0vf0 protocol 802.1Q parent ffff: \
flower \
skip_sw \
dst_mac e4:11:22:11:4a:51 \
src_mac e4:11:22:11:4a:50 \
action vlan push id 100 \
action mirred egress redirect dev p0

$ tc filter add dev p0 protocol 802.1Q parent ffff: \
flower \
skip_sw \
dst_mac e4:11:22:11:4a:51 \
src_mac e4:11:22:11:4a:50 \
vlan_ethertype 0x800 \
vlan_id 100 \
vlan_prio 0 \
action vlan pop \
action mirred egress redirect dev pf0vf0
```

## VXLAN Encap/Decap Example

```
$ tc filter add dev pf0vf0 protocol 0x806 parent ffff: \
flower \
```

```
skip_sw \
dst_mac e4:11:22:11:4a:51 \
src_mac e4:11:22:11:4a:50 \
action tunnel_key set \
src_ip 20.1.12.1 \
dst_ip 20.1.11.1 \
id 100 \
action mirred egress redirect dev vxlan100

$ tc filter add dev vxlan100 protocol 0x806 parent ffff: \
flower \
skip_sw \
dst_mac e4:11:22:11:4a:51 \
src_mac e4:11:22:11:4a:50 \
enc_src_ip 20.1.11.1 \
enc_dst_ip 20.1.12.1 \
enc_key_id 100 \
enc_dst_port 4789 \
action tunnel_key unset \
action mirred egress redirect dev pf0vf0
```

## VirtIO Acceleration Through Hardware vDPA

For configuration procedure, please refer to the [MLNX\\_OFED documentation](#) under OVS Offload Using ASAP<sup>2</sup> Direct > VirtIO Acceleration through Hardware vDPA.

## Configuring Uplink MTU

To configure the port MTU while operating in [SmartNIC mode](#), you must restrict the external host port ownership by issuing the following command on the DPU:

```
mlxprivhost -d /dev/mst/<pciconf0 device> r --disable_port_owner
```

Server cold reboot is required for this restriction to take effect.

Once the host is restricted, the port MTU is configured by changing the MTU of the uplink representor (p0 or p1).

# Link Aggregation

Network bonding enables combining two or more network interfaces into a single interface. It increases the network throughput, bandwidth and provides redundancy if one of the interfaces fails.

NVIDIA ® BlueField ® DPU has an option to configure network bonding on the Arm side in a manner transparent to the host. Under such configuration, the host would only see a single PF.

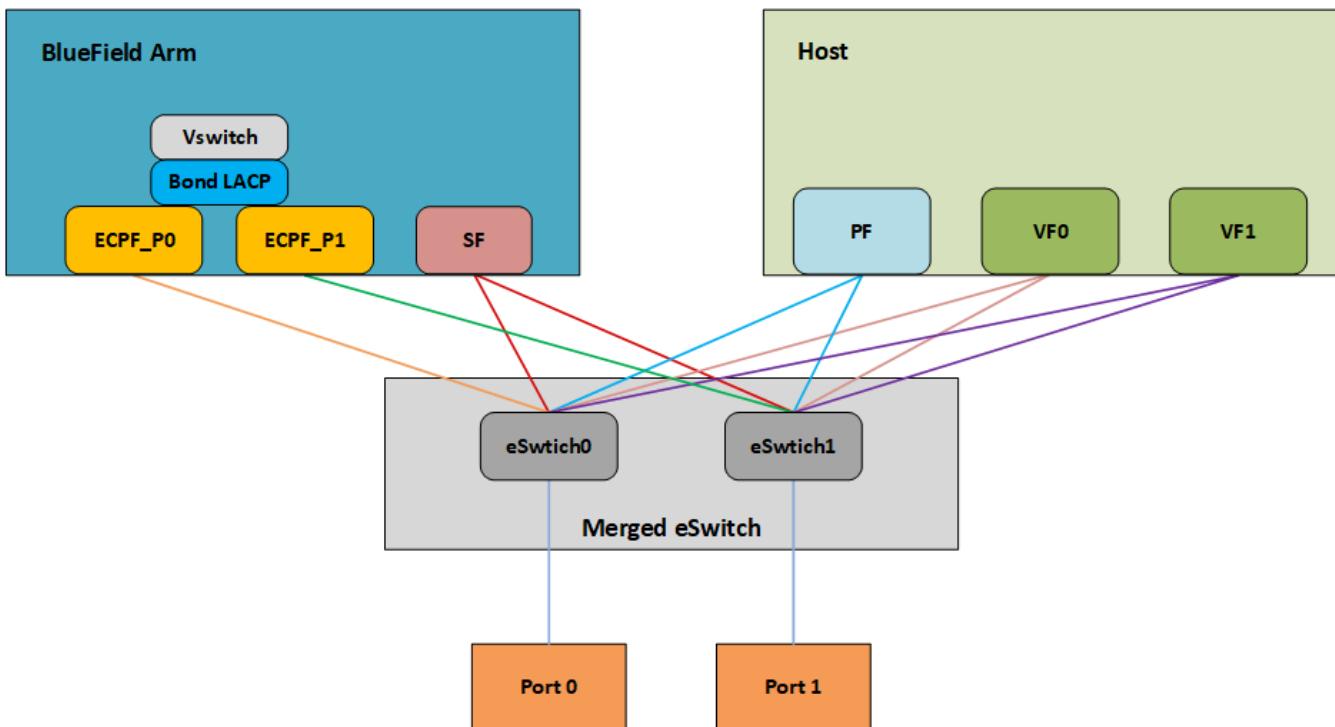
## Note

This functionality is supported when the DPU is set in embedded function ownership mode for both ports.

## Note

While LAG is being configured (starting with step 2 under section "[LAG Configuration](#)"), traffic cannot pass through the physical ports.

The diagram below describes this configuration:



## LAG Modes

Two LAG modes are supported on BlueField:

- Queue Affinity mode
- Hash mode

## Queue Affinity Mode

In this mode, packets are distributed according to the QPs.

1. To enable this mode, run:

```
$ mlxconfig -d /dev/mst/<device-name> s LAG_RESOURCE_ALLOCATION=0
```

Example device name: mt41686\_pciconf0.

2. Add/edit the following field from /etc/mellanox/mlnx-bf.conf as follows:

```
LAG_HASH_MODE="no"
```

3. Perform a BlueField system reboot for the mlxconfig settings to take effect. Refer to the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page for instructions.

## Hash Mode

In this mode, packets are distributed to ports according to the hash on packet headers.

 **Note**

For this mode, prerequisite steps 3 and 4 are not required.

1. To enable this mode, run:

```
$ mlxconfig -d /dev/mst/<device-name> s LAG_RESOURCE_ALLOCATION=1
```

Example device name: mt41686\_pciconf0.

2. Add/edit the following field from /etc/mellanox/mlnx-bf.conf as follows:

```
LAG_HASH_MODE="yes"
```

3. Perform a BlueField system reboot for the mlxconfig settings to take effect. Refer to the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page for instructions.

## Prerequisites

1. Set the LAG mode to work with.
2. (Optional) Hide the second PF on the host. Run:

```
$ mlxconfig -d /dev/mst/<device-name> s HIDE_PORT2_PF=True NUM_OF_PF=1
```

Example device name: mt41686\_pciconf0.

 **Note**

Perform a BlueField system reboot for the `mlxconfig` settings to take effect. Refer to the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page for instructions.

3. Delete any installed Scalable Functions (SFs) on the Arm side.

4. Stop the driver on the host side. Run:

```
$ systemctl stop openibd
```

5. The uplink interfaces (`p0` and `p1`) on the Arm side must be disconnected from any OVS bridge.

## LAG Configuration

1. Create the bond interface. Run:

```
$ ip link add bond0 type bond  
$ ip link set bond0 down  
$ ip link set bond0 type bond miimon 100 mode 4 xmit_hash_policy layer3+4
```

 **Note**

While LAG is being configured (starting with the next step), traffic cannot pass through the physical ports.

2. Subordinate both the uplink representors to the bond interface. Run:

```
$ ip link set p0 down  
$ ip link set p1 down  
$ ip link set p0 master bond0  
$ ip link set p1 master bond0
```

3. Bring the interfaces up. Run:

```
$ ip link set p0 up  
$ ip link set p1 up  
$ ip link set bond0 up
```

The following is an example of LAG configuration in Ubuntu:

```
# cat /etc/network/interfaces  
  
# interfaces(5) file used by ifup(8) and ifdown(8)  
# Include files from /etc/network/interfaces.d:  
source /etc/network/interfaces.d/*  
auto lo  
iface lo inet loopback  
#p0  
auto p0  
iface p0 inet manual  
bond-master bond1  
#  
#p1  
auto p1  
iface p1 inet manual
```

```
bond-master bond1
#bond1
auto bond1
iface bond1 inet static
address 192.168.1.1
netmask 255.255.0.0
mtu 1500
bond-mode 2
bond-slaves p0 p1
bond-miimon 100
pre-up (sleep 2 && ifup p0) &
pre-up (sleep 2 && ifup p1) &
```

As a result, only the first PF of the DPU would be available to the host side for networking and SR-IOV.

### **Warning**

When in shared RQ mode (enabled by default), the uplink interfaces (p0 and p1) must always stay enabled. Disabling them will break LAG support and VF-to-VF communication on same host.

For OVS configuration, the bond interface is the one that needs to be added to the OVS bridge (interfaces p0 and p1 should not be added). The PF representor for the first port (pf0hpf) of the LAG must be added to the OVS bridge. The PF representor for the second port (pf1hpf) would still be visible, but it should not be added to OVS bridge. Consider the following examples:

```
ovs-vsctl add-br bf-lag
ovs-vsctl add-port bf-lag bond0
ovs-vsctl add-port bf-lag pf0hpf
```

## **Warning**

Trying to change bonding configuration in Queue Affinity mode (including bringing the subordinated interface up/down) while the host driver is loaded would cause FW syndrome and failure of the operation. Make sure to unload the host driver before altering DPU bonding configuration to avoid this.

## **Note**

When performing driver reload (openibd restart) or reboot, it is required to remove bond configuration and to reapply the configurations after the driver is fully up. Refer to steps 1-4 of "[Removing LAG Configuration](#)".

## **Removing LAG Configuration**

1. If Queue Affinity mode LAG is configured (i.e., LAG\_RESOURCE\_ALLOCATION=0):

1. Delete any installed Scalable Functions (SFs) on the Arm side.
2. Stop driver (openibd) on the host side. Run:

```
systemctl stop openibd
```

2. Delete the LAG OVS bridge on the Arm side. Run:

```
ovs-vsctl del-br bf-lag
```

This allows for later restoration of OVS configuration for non-LAG networking.

3. Stop OVS service. Run:

```
systemctl stop openvswitch-switch.service
```

4. Run:

```
ip link set bond0 down  
modprobe -rv bonding
```

As a result, both of the DPU's network interfaces would be available to the host side for networking and SR-IOV.

5. For the host to be able to use the DPU ports, make sure to attach the ECPF and host representor in an OVS bridge on the Arm side. Refer to "[Virtual Switch on DPU](#)" for instructions on how to perform this.

6. Revert from HIDE\_PORT2\_PF, on the Arm side. Run:

```
mlxconfig -d /dev/mst/<device-name> s HIDE_PORT2_PF=False NUM_OF_PF=2
```

7. Restore default LAG settings in the DPU's firmware. Run:

```
mlxconfig -d /dev/mst/<device-name> s  
LAG_RESOURCE_ALLOCATION=DEVICE_DEFAULT
```

8. Delete the following line from /etc/mellanox/mlnx-bf.conf on the Arm side:

```
LAG_HASH_MODE=...
```

9. Perform a BlueField system reboot for the mlxconfig settings to take effect. Refer to the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page for instructions.

## LAG on Multi-host

Only LAG hash mode is supported with BlueField multi-host.

## LAG Multi-host Prerequisites

1. Enable LAG hash mode.
2. Hide the second PF on the host. Run:

```
$ mlxconfig -d /dev/mst/<device-name> s HIDE_PORT2_PF=True NUM_OF_PF=1
```

3. Make sure NVME emulation is disabled:

```
$ mlxconfig -d /dev/mst/<device-name> s NVME_EMULATION_ENABLE=0
```

Example device name: mt41686\_pciconf0.

4. The uplink interfaces (p0 and p4) on the Arm side, representing port0 and port1, must be disconnected from any OVS bridge. As a result, only the first PF of the DPU would be available to the host side for networking and SR-IOV.

## LAG Configuration on Multi-host

1. Create the bond interface. Run:

```
$ ip link add bond0 type bond  
$ ip link set bond0 down  
$ ip link set bond0 type bond miimon 100 mode 4 xmit_hash_policy layer3+4
```

2. Subordinate both the uplink representors to the bond interface. Run:

```
$ ip link set p0 down  
$ ip link set p4 down  
$ ip link set p0 master bond0  
$ ip link set p4 master bond0
```

3. Bring the interfaces up. Run:

```
$ ip link set p0 up  
$ ip link set p4 up  
$ ip link set bond0 up
```

4. For OVS configuration, the bond interface is the one that must be added to the OVS bridge (interfaces p0 and p4 should not be added). The PF representor, pf0hpf, must be added to the OVS bridge with the bond interface. The rest of the uplink representors must be added to another OVS bridge along with their PF representors. Consider the following examples:

```
ovs-vsctl add-br br-lag  
ovs-vsctl add-port br-lag bond0  
ovs-vsctl add-port br-lag pf0hpf  
ovs-vsctl add-br br1  
ovs-vsctl add-port br1 p1  
ovs-vsctl add-port br1 pf1hpf  
ovs-vsctl add-br br2  
ovs-vsctl add-port br2 p2  
ovs-vsctl add-port br2 pf2hpf  
ovs-vsctl add-br br3  
ovs-vsctl add-port br3 p3  
ovs-vsctl add-port br3 pf3hpf
```

 **Note**

When performing driver reload (openibd restart) or reboot, you must remove bond configuration from NetworkManager, and to reapply the configurations after the driver is fully up.

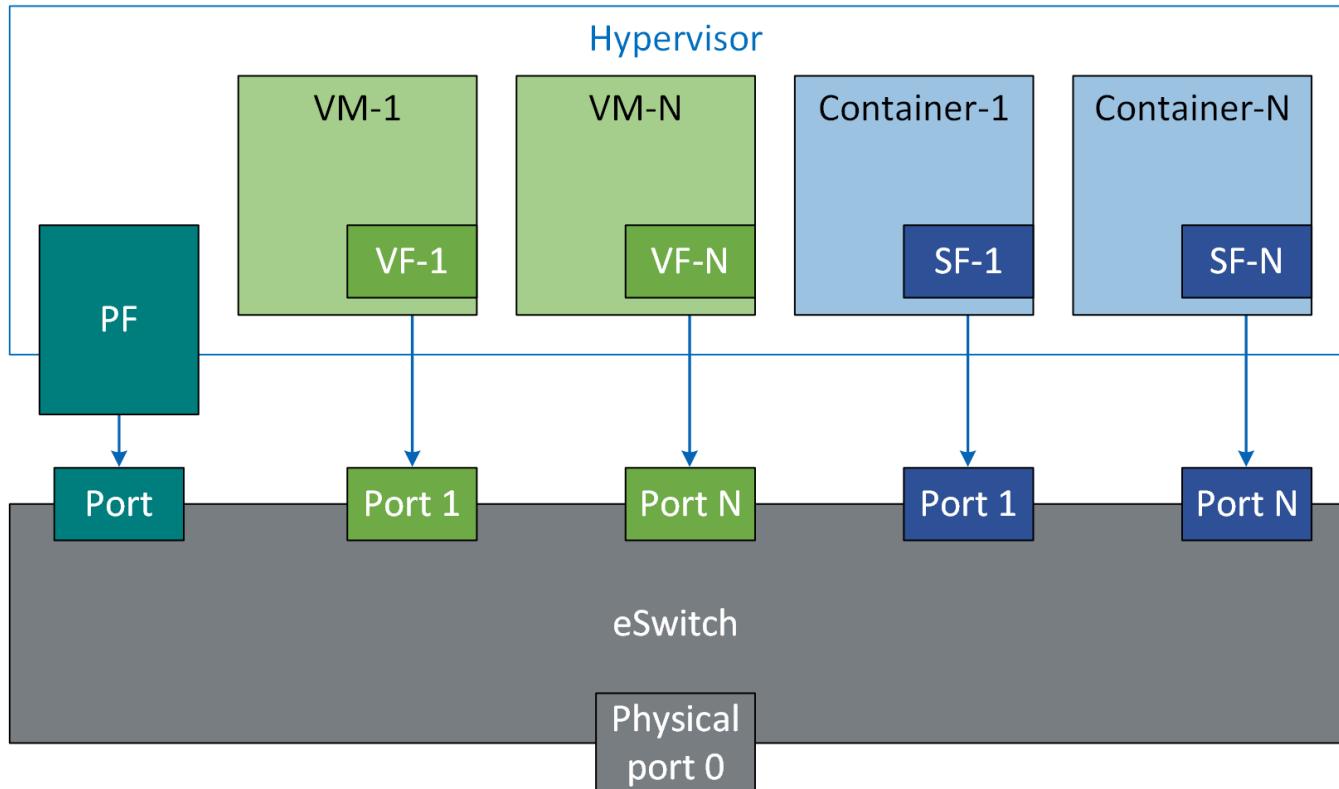
## Removing LAG Configuration on Multi-host

Refer to section "[Removing LAG Configuration](#)".

# Scalable Functions

A scalable function (SF) is a lightweight function that has a parent PCIe function on which it is deployed. An mlx5 SF has its own function capabilities and its own resources. This means that an SF has its own dedicated queues (txq, rxq, cq, eq) which are neither shared nor stolen from the parent PCIe function.

No special support is needed from system BIOS to use SFs. SFs co-exist with PCIe SR-IOV virtual functions. SFs do not require enabling PCIe SR-IOV.



## Scalable Function Configuration

The following procedure offers a guide on using scalable functions with upstream Linux kernel.

## Device Configuration

1. Make sure your firmware version supports SFs (20.30.1004 and above).

2. Enable SF support in device. Run:

```
$ mlxconfig -d 0000:03:00.0 s PF_BAR2_ENABLE=0 PER_PF_NUM_SF=1  
PF_TOTAL_SF=236 PF_SF_BAR_SIZE=10
```

3. Perform a BlueField system reboot for the mlxconfig settings to take effect. Refer to the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page for instructions.

## Mandatory Kernel Configuration on Host

Support for Linux kernel mlx5 SFs must be enabled as it is disabled by default.

The following two Kconfig flags must be enabled.

- MLX5\_ESWITCH
- MLX5\_SF

## Software Control and Commands

SFs use a 4-step process as follows:

- Create
- Configure
- Deploy
- Use

SFs are managed using mlxdevm tool. It is located under directory /opt/mellanox/iproute2/sbin/mlxdevm.

1. Display the physical (i.e. uplink) port of the PF. Run:

```
$ devlink port show  
pci/0000:03:00.0/65535: type eth netdev p0 flavour physical port 0 splittable  
false
```

2. Add an SF. Run:

```
$ mlxdevm port add pci/0000:03:00.0 flavour pcisf pfnum 0 sfnum 88  
pci/0000:03:00.0/229409: type eth netdev eth0 flavour pcisf controller 0 pfnum  
0 sfnum 88  
function:  
hw_addr 00:00:00:00:00:00 state inactive opstate detached trust off
```

 **Note**

An added SF is still not usable for the end-user application. It can only be used after configuration and activation.

 **Note**

SF number  $\geq 1\ 000$  is reserved for the [virtio-net controller](#).

When an SF is added on the external controller (e.g. DPU) users must supply the controller number. In a single host DPU case, there is only one controller starting with controller number 1.

Example of adding an SF for PF0 of external controller 1:

```
$ mlxdevm port add pci/0000:03:00.0 flavour pcisf pfnum 0 sfnum 88
controller 1
pci/0000:03:00.0/32768: type eth netdev eth6 flavour pcisf controller 1 pfnum
0 sfnum 88 splittable false
function:
hw_addr 00:00:00:00:00:00 state inactive opstate detached
```

3. Show the newly added devlink port by its port index or its representor device.

```
$ mlxdevm port show en3f0pf0sf88
pci/0000:03:00.0/229409: type eth netdev en3f0pf0sf88 flavour pcisf controller
0 pfnum 0 sfnum 88
function:
hw_addr 00:00:00:00:00:00 state inactive opstate detached trust off
```

Or:

```
$ mlxdevm port show pci/0000:03:00.0/229409
pci/0000:03:00.0/229409: type eth netdev en3f0pf0sf88 flavour pcisf controller
0 pfnum 0 sfnum 88
function:
hw_addr 00:00:00:00:00:00 state inactive opstate detached trust off
```

4. Set the MAC address of the SF. Run:

```
$ mlxdevm port function set pci/0000:03:00.0/229409 hw_addr
00:00:00:00:88:88
```

5. Set SF as trusted (optional). Run:

```
$ mlxdevm port function set pci/0000:03:00.0/229409 trust on
pci/0000:03:00.0/229409: type eth netdev en3f0pf0sf88 flavour pcisf controller
0 pfnum 0 sfnum 88
function:
```

```
hw_addr 00:00:00:00:88:88 state inactive opstate detached trust on
```

 **Note**

A trusted function has additional privileges like the ability to update steering database.

6. Configure OVS. Run:

```
$ systemctl start openvswitch  
$ ovs-vsctl add-br network1  
$ ovs-vsctl add-port network1 ens3f0npf0sf88  
$ ip link set dev ens3f0npf0sf88 up
```

7. Activate the SF. Run:

```
$ mlxdevm port function set pci/0000:03:00.0/229409 state active
```

Activating the SF results in creating an auxiliary device and initiating driver load sequence for netdevice, RDMA, and VDPA devices. Once the operational state is marked as attached, a driver is attached to this SF and device loading begins.

 **Note**

An application interested in using the SF netdevice and rdma device must monitor the RDMA and netdevices either through udev monitor or poll the sysfs hierarchy of the SF's auxiliary device.

8. By default, SF is attached to the configuration driver `mlx5_core.sf_cfg`. Users must unbind an SF from the configuration and bind it to the `mlx5_core.sf` driver to make use

of it. Run:

```
$ echo mlx5_core.sf.4 >
/sys/bus/auxiliary/devices/mlx5_core.sf.4/driver/unbind
$ echo mlx5_core.sf.4 > /sys/bus/auxiliary/drivers/mlx5_core.sf/bind
```

9. View the new state of the SF. Run:

```
$ mlxdevm port show en3f0pf0sf88 -jp
{
  "port": {
    "pci/0000:03:00.0/229409": {
      "type": "eth",
      "netdev": "en3f0pf0sf88",
      "flavour": "pcisf",
      "controller": 0,
      "pfnum": 0,
      "sfnum": 88,
      "function": {
        "hw_addr": "00:00:00:00:88:88",
        "state": "active",
        "opstate": "detached",
        "trust": "on"
      }
    }
  }
}
```

10. View the auxiliary device of the SF. Run:

```
$ cat /sys/bus/auxiliary/devices/mlx5_core.sf.4/sfnum
88
```

There can be hundreds of auxiliary SF devices on the auxiliary bus. Each SF's auxiliary device contains a unique sfnum and PCI information.

11. View the parent PCI device of the SF. Run:

```
$ readlink /sys/bus/auxiliary/devices/mlx5_core.sf.1  
../../../../devices/pci0000:00/0000:00:00.0/0000:01:00.0/0000:02:00.0/0000:03:00.0/r
```

12. View the devlink instance of the SF device. Run:

```
$ devlink dev show  
$ devlink dev show auxiliary/mlx5_core.sf.4
```

13. View the port and netdevice associated with the SF. Run:

```
$ devlink port show auxiliary/mlx5_core.sf.4/1  
auxiliary/mlx5_core.sf.4/1: type eth netdev enp3s0f0s88 flavour virtual port 0  
splittable false
```

14. View the RDMA device for the SF. Run:

```
$ rdma dev show  
$ ls /sys/bus/auxiliary/devices/mlx5_core.sf.4/infiniband/
```

15. Deactivate SF. Run:

```
$ mlxdevm port function set pci/0000:03:00.0/229409 state inactive
```

Deactivating the SF triggers driver unload in the host system. Once SF is deactivated, its operational state changes to "detached". An orchestration system should poll for the operational state to be changed to "detached" before deleting the SF. This ensures a graceful hot-unplug.

16. Delete SF. Run:

```
$ mlxdevm port del pci/0000:03:00.0/229409
```

Finally, once the state is "inactive" and the operational state is "detached" the user can safely delete the SF. For faster provisioning, a user can reconfigure and active the SF again without deletion.

## RDMA Stack Support on Host and Arm System

Full RDMA stack is pre-installed on the Arm Linux system. RDMA, whether RoCE or InfiniBand, is supported on BlueField® DPU in the configurations listed below.

### Separate Host Mode

RoCE is supported from both the host and Arm system.

InfiniBand is supported on the host system.

### Embedded CPU Mode

#### RDMA Support on Host

To use RoCE on a host system's PCIe PF, OVS hardware offloads must be enabled on the Arm system.

RoCE is not supported by connection tracking offload. Please refer to "[Configuring Connection Tracking Offload](#)" for a workaround for it.

#### RDMA Support on Arm

RoCE is unsupported on the Arm system on the PCIe PF. However, RoCE is fully supported using scalable function as explained under "[Scalable Functions](#)". Scalable functions are

created by default, allowing RoCE traffic without further configuration.

InfiniBand is supported on the Arm system on the PCIe PF in this mode.

## Controlling Host PF and VF Parameters

NVIDIA® BlueField® allows control over some of the networking parameters of the PFs and VFs running on the host side.

### Setting Host PF and VF Default MAC Address

From the Arm, users may configure the MAC address of the physical function in the host. After sending the command, users must reload the NVIDIA driver in the host to see the newly configured MAC address. The MAC address goes back to the default value in the FW after system reboot.

Example:

```
$ echo "c4:8a:07:a5:29:59" > /sys/class/net/p0-smart_nic/pf/mac  
$ echo "c4:8a:07:a5:29:61" > /sys/class/net/p0-smart_nic/vf0/mac
```

### Setting Host PF and VF Link State

vPort state can be configured to Up, Down, or Follow. For example:

```
$ echo "Follow" > /sys/class/net/p0-smart_nic/pf/vport_state
```

### Querying Configuration

To query the current configuration, run:

```
$ cat /sys/class/net/p0-smart_nic/pf/config
```

MAC : e4:8b:01:a5:79:5e

MaxTxRate : 0

State : Follow

Zero signifies that the rate limit is unlimited.

## Disabling Host Networking PFs

It is possible to not expose ConnectX networking functions to the host for users interested in using storage or VirtIO functions only. When this feature is enabled, the host PF representors (i.e. pf0hpf and pf1hpf) will not be seen on the Arm.

- Without a PF on the host, it is not possible to enable SR-IOV, so VF representors will not be seen on the Arm either
- Without PFs on the host, there can be no SFs on it

To disable host networking PFs, run:

```
mlxconfig -d /dev/mst/mt41686_pciconf0 s NUM_OF_PF=0
```

To reactivate host networking PFs:

- For single-port DPUs, run:

```
mlxconfig -d /dev/mst/mt41686_pciconf0 s NUM_OF_PF=1
```

- For dual-port DPUs, run:

```
mlxconfig -d /dev/mst/mt41686_pciconf0 s NUM_OF_PF=2
```

### Note

When there are no networking functions exposed on the host, the reactivation command must be run from the Arm.

### **Note**

Perform a BlueField system reboot for the mlxconfig settings to take effect. Refer to the "NVIDIA BlueField Reset and Reboot Procedures" troubleshooting page for instructions.

## DPDK on BlueField DPU

Please refer to "[NVIDIA BlueField Board Support Package](#)" in the DPDK documentation.

## BlueField SNAP

NVIDIA® BlueField® SNAP (Software-defined Network Accelerated Processing) technology enables hardware-accelerated virtualization of NVMe storage. BlueField SNAP presents networked storage as a local NVMe SSD, emulating an NVMe drive on the PCIe bus. The host OS/Hypervisor makes use of its standard NVMe-driver unaware that the communication is terminated, not by a physical drive, but by the BlueField SNAP. Any logic may be applied to the data via the BlueField SNAP framework and transmitted over the network, on either Ethernet or InfiniBand protocol, to a storage target.

BlueField SNAP combines unique hardware-accelerated storage virtualization with the advanced networking and programmability capabilities of the DPU. BlueField SNAP together with the DPU enable a world of applications addressing storage and networking efficiency and performance.

To enable BlueField SNAP, please refer to the [NVIDIA BlueField-3 SNAP for NVMe and Virtio-blk](#) documentation.

# BlueField SR-IOV

The BlueField SR-IOV solution is based on asymmetric VF and enables per-ECPF and per PF control over number of VF allocation .

ECPF VFs are intended to be used in switchdev mode. Like SFs and host VFs, ECPF VFs have a representor. Representor naming for ECPF VFs start after the host VFs. For example, if the host has 32 VFs enabled, then the host VF representors are named pf0vf0-pf0vf31, and the Arm representors continue at pf0vf32 onward.

To enable BlueField SR-IOV, apply the following configuration in the BlueField OS:

```
mlxconfig -d 03:00.0 -y s PF_NUM_OF_VF_VALID=1
```

## Note

Once PF\_NUM\_OF\_VF\_VALID is set, the NUM\_OF\_VFS mlxconfig option is not relevant and the user must set PF\_NUM\_OF\_VF for each host and EC function. It is recommended for the number of VFs for each ECPF and each host PF be the same.

The BlueField should now support setting asymmetric VF configuration per port.

The following are examples for configuring the number of VFs per port:

1. In the BlueField, issue the following commands to configure 32 VFs per port:

```
dpu> mlxconfig -d 03:00.0 -y s PF_NUM_OF_VF=32  
dpu> mlxconfig -d 03:00.1 -y s PF_NUM_OF_VF=32
```

## Note

The BlueField ECPF driver in the BlueField's Arm OS limits the number of VFs it supports to 32 per port.

2. In the host OS, issue the following commands to configure up to 126 VFs per port:

```
host> mlxconfig -d 03:00.0 -y s PF_NUM_OF_VF=126  
host> mlxconfig -d 03:00.1 -y s PF_NUM_OF_VF=126
```

3. Perform a BlueField system reboot for the mlxconfig settings to take effect.

4. Create ECPF VFs:

```
echo 1 > /sys/class/net/p0/device/sriov_numvfs
```

### Note

BlueField SR-IOV VFs do not support the following legacy SRIOV functionalities:

- Virtual switch tagging (VF VLAN)
- Spoof check
- VF trust
- VF rate

## Compression Acceleration

NVIDIA® BlueField® DPU supports high-speed compression acceleration. This feature allows the host to offload multiple compression/decompression jobs to the DPU.

Compress-class operations are supported in parallel to the net, vDPA, and RegEx class operations.

## Configuring Compression Acceleration

The compression application can run either from the host or Arm.

For more information, please refer to:

- [The DPDK community documentation about compression](#)
- [The mlx5 support documentation](#)

## Public Key Acceleration

NVIDIA BlueField DPU incorporates several public key acceleration (PKA) engines to offload the processor of the Arm host, providing high-performance computation of PK algorithms. BlueField's PKA is useful for a wide range of security applications. It can assist with SSL acceleration, or a secure high-performance PK signature generator/checker and certificate related operations.

BlueField's PKA software libraries implement a simple, complete framework for crypto public key infrastructure (PKI) acceleration. It provides direct access to hardware resources from the user space and makes available a number of arithmetic operations—some basic (e.g., addition and multiplication), and some complex (e.g., modular exponentiation and modular inversion)—and high-level operations such as RSA, Diffie-Hallman, Elliptic Curve Cryptography, and the Federal Digital Signature Algorithm (DSA as documented in FIPS-186) public-private key systems.

## PKA Prerequisites

- The BlueField PKA software is intended for BlueField products with HW accelerated crypto capabilities. To verify whether your BlueField chip has crypto capabilities, look for CPU flags aes, sha1, and sha2 in the DPU OS. For example:

```
# lscpu  
...  
Flags: fp asimd evtstrm aes pmull sha1 sha2 crc32 cpuid
```

- BlueField bootloader must enable SMMU support to benefit from the full hardware and software capabilities. SMMU support may be enabled in UEFI menu through system configuration options.

## PKA Use Cases

Some of the use cases for the BlueField PKA involve integrating OpenSSL software applications with BlueField's PKA hardware. The BlueField PKA dynamic engine for OpenSSL allows applications integrated with OpenSSL (e.g., StrongSwan) to accomplish a variety of security-related goals and to accelerate the cryptographic processing with the BlueField PKA hardware. OpenSSL versions  $\geq 1.0.0$ ,  $\leq 1.1.1$ , and 3.0.2 are supported.

 **Note**

With CentOS 7.6, only OpenSSL 1.1 (not 1.0) works with PKA engine and keygen. Use `openssl11` with PKA engine and keygen.

The engine supports the following operations:

- RSA
- DH
- DSA
- ECDSA
- ECDH
- Random number generation that is cryptographically secure.

Up to 4096-bit keys for RSA, DH, and DSA operations are supported. Elliptic Curve Cryptography support of (nist) prime curves for 160, 192, 224, 256, 384 and 521 bits.

For example, to sign a file using BlueField's PKA engine:

```
$ openssl dgst -engine pka -sha256 -sign <privatekey> -out <signature> <filename>
```

To verify the signature, execute:

```
$ openssl dgst -engine pka -sha256 -verify <publickey> -signature <signature>  
<filename>
```

For further details on BlueField PKA, please refer to "PKA Driver Design and Implementation Architecture Document" and/or "PKA Programming Guide". Directions and instructions on how to integrate the BlueField PKA software libraries are provided in the README files on the [Mellanox PKA GitHub](#).

## IPsec Functionality

### Transparent IPsec Encryption and Decryption

BlueField DPU can offload IPsec operations transparently from the host CPU. This means that the host does not need to be aware that network traffic is encrypted before hitting the wire or decrypted after coming off the wire. IPsec operations can be run on the DPU in software on the Arm cores or in the accelerator block.

### IPsec Hardware Offload: Crypto Offload

IPsec hardware crypto offload, also known as IPsec inline offload or IPsec aware offload, enables the user to offload IPsec crypto encryption and decryption operations to the hardware, leaving the encapsulation/decapsulation task to the software.

Please refer to the [MLNX\\_OFED documentation](#) under Features Overview and Configuration > Ethernet Network > IPsec Crypto Offload for more information on enabling and configuring this feature.

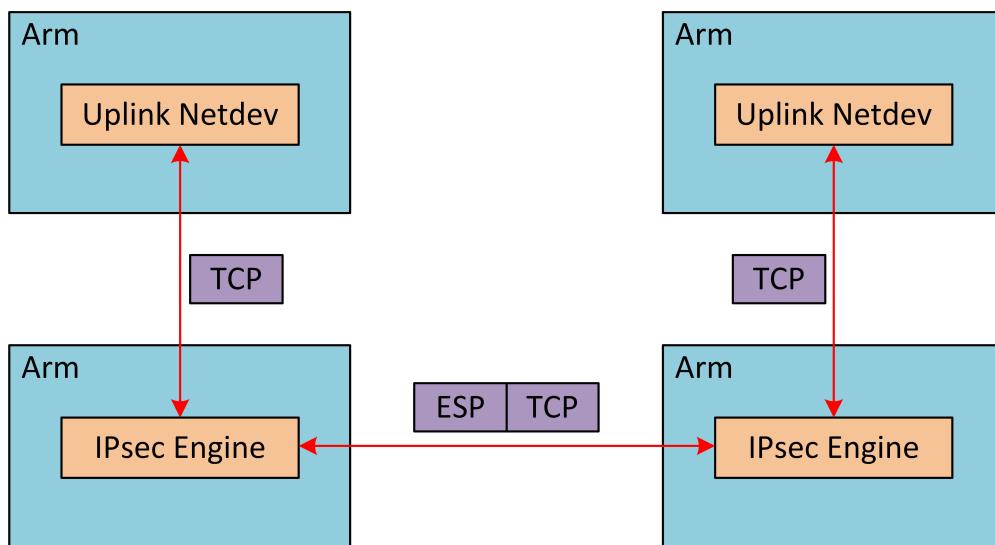
Please note that to use IPsec crypto offload with OVS, you must disable hardware offloads.

### IPsec Hardware Offload: Packet Offload

## (i) Note

IPSec packet offload is only supported on Ubuntu BlueField kernel 5.15

IPsec packet offload offloads both IPsec crypto and IPsec encapsulation to the hardware. IPsec packet offload is configured on the Arm via the uplink netdev. The following figure illustrates IPsec packet offload operation in hardware.



## Enabling IPsec Packet Offload

Explicitly enable IPsec packet offload on the Arm cores before setting up offload-aware IPsec tunnels .

## (i) Note

If an OVS VXLAN tunnel configuration already exists, stop openvswitch service prior to performing the steps below and restart the service afterwards.

Explicitly enable IPsec full offload on the Arm cores.

1. Set `IPSEC_FULL_OFFLOAD="yes"` in `/etc/mellanox/mlnx-bf.conf`.

2. Restart IB driver (rebooting also works). Run:

```
/etc/init.d/openibd restart
```

**(i) Note**

If `mlx-regex` is running:

1. Disable `mlx-regex`:

```
systemctl stop mlx-regex
```

2. Restart IB driver according to the command above.

3. Re-enable `mlx-regex` after the restart has finished:

```
systemctl restart mlx-regex
```

**(i) Note**

To revert IPsec full offload mode, redo the procedure from step 1, only difference is to set `IPSEC_FULL_OFFLOAD="no"` in `/etc/mellanox/mlnx-bf.conf`.

**(i) Note**

To use IPsec packet offload with strongSwan, refer to section "[IPsec Packet Offload strongSwan Support](#)".

To configure IPsec rules, please follow the instructions in [MLNX\\_OFED documentation](#) under Features Overview and Configuration > Ethernet Network > IPsec Crypto Offload > Configuring Security Associations for IPsec Offloads but, use "offload packet" to achieve IPsec Packet offload.

## Configuring IPsec Rules with iproute2

 **Note**

If you are working directly with the ip xfrm tool, you must use the /opt/mellanox/iproute2/sbin/ip to benefit from IPsec packet offload support.

The following example configures IPsec packet offload rules with local address 192.168.1.64 and remote address 192.168.1.65:

```
ip xfrm state add src 192.168.1.64/24 dst 192.168.1.65/24 proto esp spi 0x4834535d  
reqid 0x4834535d mode transport aead 'rfc4106(gcm(aes))'  
0xc57f6f084ebf8c6a71dd9a053c2e03b94c658a9bf00dd25780e73948931d10d08058a2  
128 offload packet dev p0 dir out sel src 192.168.1.64 dst 192.168.1.65  
ip xfrm state add src 192.168.1.65/24 dst 192.168.1.64/24 proto esp spi 0x2be60844  
reqid 0x2be60844 mode transport aead 'rfc4106(gcm(aes))'  
0xacacca06b66489011d3c1c21f1a36d925cf7449d3aeaa6fe534446c3a8f8bd5f5fdc26658  
128 offload packet dev p0 dir in sel src 192.168.1.65 dst 192.168.1.64  
sudo ip xfrm policy add src 192.168.1.64 dst 192.168.1.65 offload packet dev p0 dir  
out tmpl src 192.168.1.64/24 dst 192.168.1.65/24 proto esp reqid 0x4834535d mode  
transport
```

```
sudo ip xfrm policy add src 192.168.1.65 dst 192.168.1.64 offload packet dev p0 dir in tmpl src 192.168.1.65/24 dst 192.168.1.64/24 proto esp reqid 0x2be60844 mode transport
```

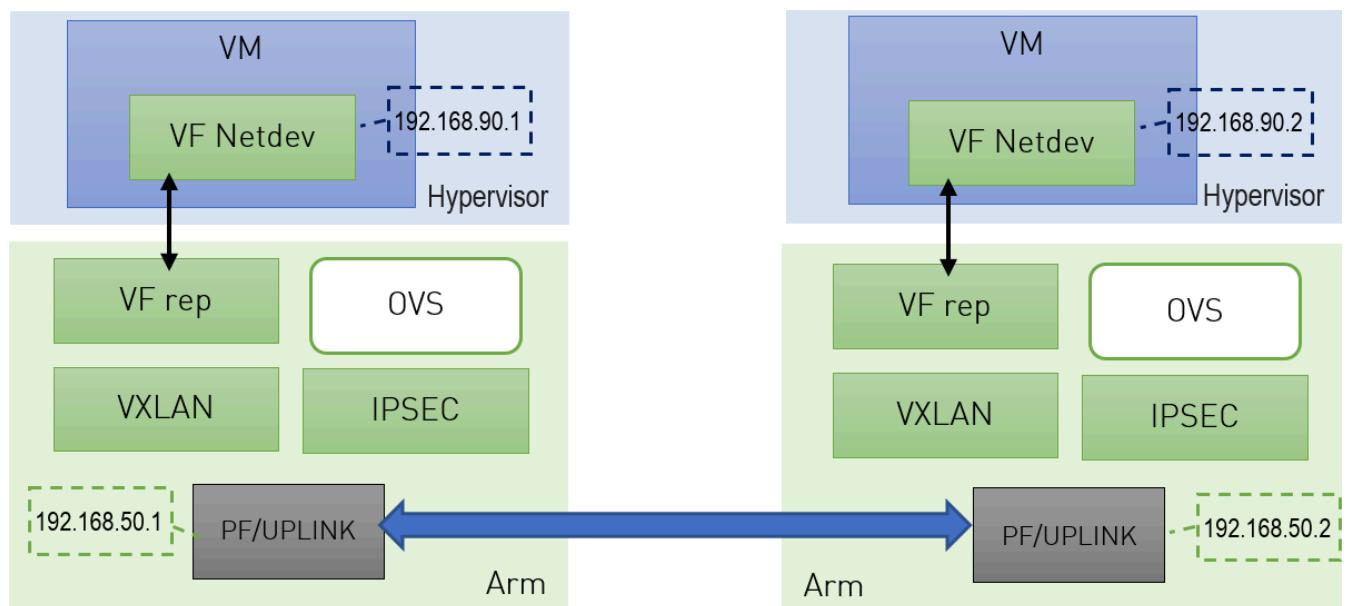
### (i) Note

The numbers used by the spi, reqid, or aead algorithms are random. These same numbers are also used in the configuration of peer Arm. Do not confuse these numbers with source and destination IPs. The connection may fail if they are not consistent.

## IPsec Packet Offload strongSwan Support

BlueField DPU supports configuring IPsec rules using strongSwan 5.9.10—appears as 5.9.10bf in the BFB which is based on upstream 5.9.10 version—which supports new fields in the swanctl.conf file.

The following figure illustrates an example with two BlueField DPUs , Left and Right, operating with a secured VXLAN channel .



Support for strongSwan IPsec packet HW offload requires using VXLAN together with IPsec as shown here .

1. Follow the procedure under section "[Enabling IPsec Packet Offload](#)".
2. Follow the procedure under section "[VXLAN Tunneling Offload](#)" to configure VXLAN on Arm.

 **Note**

Make sure the MTU of the PF used by VXLAN is at least 50 bytes larger than VXLAN-REP MTU.

3. Enable tc offloading. Run:

```
ethtool -K <PF> hw-tc-offload on
```

 **Note**

Do not add the PF itself using "ovs-vsctl add-port" to the OVS.

## Setting IPsec Packet Offload Using strongSwan

strongSwan configures IPsec HW packet offload using a new value added to its configuration file swanctl.conf (as of strongSwan version 5.9.10).

The file should be placed under "sysconfdir" which by default can be found at /etc/swanctl/swanctl.conf.

The terms Left (BFL) and Right (BFR) are used to identify the two nodes that communicate (corresponding with [the figure](#) under section "[IPsec Packet Offload strongSwan Support](#)").

In this example, 192.168.50.1 is used for the left PF uplink and 192.168.50.2 for the right PF uplink.

```
connections {
    BFL-BFR {
        local_addrs = 192.168.50.1
        remote_addrs = 192.168.50.2

        local {
            auth = psk
            id = host1
        }
        remote {
            auth = psk
            id = host2
        }
        children {
            bf-out {
                local_ts = 192.168.50.1/24 [udp]
                remote_ts = 192.168.50.2/24 [udp/4789]
                esp_proposals = aes128gcm128-x25519-esn
                mode = transport
                policies_fwd_out = yes
                hw_offload = packet
            }
            bf-in {
                local_ts = 192.168.50.1/24 [udp/4789]
                remote_ts = 192.168.50.2/24 [udp]
                esp_proposals = aes128gcm128-x25519-esn
                mode = transport
                policies_fwd_out = yes
                hw_offload = packet
            }
        }
        version = 2
        mobike = no
    }
}
```

```

reauth_time = 0
proposals = aes128-sha256-x25519
}

}

secrets {
ike-BF {
id-host1 = host1
id-host2 = host2
secret = 0sv+NkxY9LLZvwj4qCC2o/gGrWDF2d21jL
}
}

```

### Note

BFB installation will place two example swanctl.conf files for both Left and Right nodes (BFL.swanctl.conf and BFR.swanctl.conf respectively) in the strongSwan conf.d directory. Please move one of them manually to the other machine and edit it according to your configuration.

Note that:

- "hw\_offload = packet" is responsible for configuring IPsec packet offload
- Packet offload support has been added to the existing `hw_offload` field and preserves backward compatibility.

For your reference:

Value	Description
no	Do not configure HW offload

Value	Description
crypto	Configure crypto HW offload if supported by the kernel and hardware, fail if not supported
yes	Same as crypto (considered legacy)
packet	Configure packet HW offload if supported by the kernel and hardware, fail if not supported
auto	Configure packet HW offload if supported by the kernel and hardware, do not fail (perform fallback to crypto or no as necessary)

 **Note**

Whenever the value of hw\_offload is changed, strongSwan configuration must be reloaded.

- [udp/4789] is crucial for instructing strongSwan to IPSec only VXLAN communication

 **Note**

Packet HW offload can only be done on what is streamed over VXLAN.

Mind the following limitations:

Field	Limitation
reauth_time	Ignored if set
rekey_time	Do not use. Ignored if set.
rekey_bytes	Do not use. Not supported and will fail if it is set.
rekey_packets	Use for rekeying

## Running strongSwan Example

Notes:

- IPsec daemons are started by systemd `strongswan.service`, users must avoid using `strongswan-starter.service` as it is a legacy service and using both services at the same time leads to anomalous behavior
- Use `systemctl [start | stop | restart]` to control IPsec daemons through `strongswan.service`. For example, to restart, the command `systemctl restart strongswan.service` will effectively do the same thing as `ipsec restart`.

### Warning

Do **not** use `ipsec` script to restart/stop/start.

If you are using the `ipsec` script, then, in order to restart or start the daemons, `openssl.cnf.orig` must be copied to `openssl.cnf` before performing `ipsec restart` OR `ipsec start`. Then `openssl.cnf.mlnx` can be copied to `openssl.cnf` after restart or start. Failing to do so can result in errors since `openssl.cnf.mlnx` allows IPsec PK and RNG hardware offload via the OpenSSL plugin.

- On Ubuntu/Debian/Yocto, `openssl.cnf*` can be found under `/etc/ssl/`
- On CentOS, `openssl.cnf*` can be found under `/etc/pki/tls/`

- The `strongSwan` package installs `openssl.cnf` config files to enable hardware offload of PK and RNG operations via the OpenSSL plugin
- The OpenSSL dynamic engine is used to carry out the offload to hardware. OpenSSL dynamic engine ID is "pk".

Procedure:

1. Perform the following on Left and Right devices (corresponding with [the figure](#) under section "[IPsec Packet Offload strongSwan Support](#)").

```
# systemctl start strongswan.service  
# swanctl --load-all
```

The following should appear.

```
Starting strongSwan 5.9.10bf IPsec [starter]...  
no files found matching '/etc/ipsec.d/*.conf'  
# deprecated keyword 'plutodebug' in config setup  
# deprecated keyword 'virtual_private' in config setup  
loaded ike secret 'ike-BF'  
no authorities found, 0 unloaded  
no pools found, 0 unloaded  
loaded connection 'BFL-BFR'  
successfully loaded 1 connections, 0 unloaded
```

2. Perform the actual connection **on one side only** (client, Left in this case).

```
# swanctl -i --child bf-in bf-out
```

The following should appear.

```
[IKE] initiating IKE_SA BFL-BFR[1] to 192.168.50.2  
[ENC] generating IKE_SA_INIT request 0 [ SA KE No N(NATD_S_IP) N(NATD_D_IP)  
N(FRAG_SUP) N(HASH_ALG) N(REDIR_SUP) ]  
[NET] sending packet: from 192.168.50.1[500] to 192.168.50.2[500] (240 bytes)  
[NET] received packet: from 192.168.50.2[500] to 192.168.50.1[500] (273 bytes)  
[ENC] parsed IKE_SA_INIT response 0 [ SA KE No N(NATD_S_IP) N(NATD_D_IP)  
CERTREQ N(FRAG_SUP) N(HASH_ALG) N(CHDLESS_SUP) N(MULT_AUTH) ]  
[CFG] selected proposal:  
IKE:AES_CBC_128/HMAC_SHA2_256_128/PRF_HMAC_SHA2_256/CURVE_25519  
[IKE] received 1 cert requests for an unknown ca  
[IKE] authentication of 'host1' (myself) with pre-shared key
```

```
[IKE] establishing CHILD_SA bf{1}
[ENC] generating IKE_AUTH request 1 [ IDi N(INIT_CONTACT) IDr AUTH
N(USE_TRANSP) SA TSi TSr N(MULT_AUTH) N(EAP_ONLY) N(MSG_ID_SYN_SUP) ]
[NET] sending packet: from 192.168.50.1[500] to 192.168.50.2[500] (256 bytes)
[NET] received packet: from 192.168.50.2[500] to 192.168.50.1[500] (224 bytes)
[ENC] parsed IKE_AUTH response 1 [ IDr AUTH N(USE_TRANSP) SA TSi TSr
N(AUTH_LFT) ]
[IKE] authentication of 'host2' with pre-shared key successful
[IKE] IKE_SA BFL-BFR[1] established between
192.168.50.1[host1]...192.168.50.2[host2]
[IKE] scheduling reauthentication in 10027s
[IKE] maximum IKE_SA lifetime 11107s
[CFG] selected proposal: ESP:AES_GCM_16_128/NO_EXT_SEQ
[IKE] CHILD_SA bf{1} established with SPIs ce543905_i c60e98a2_o and TS
192.168.50.1/32 === 192.168.50.2/32
initiate completed successfully
```

You may now send encrypted data over the HOST VF interface (192.168.70.[1 | 2]) configured for VXLAN.

## Building strongSwan

Do this only if you want to build your own BFB and would like to rebuild strongSwan.

1. Install dependencies mentioned [here](#). libgmp-dev is missing from that list, so make sure to install that as well.
2. Git clone <https://github.com/Mellanox/strongswan.git>.
3. Git checkout BF-5.9.10. This branch is based on the [official strongSwan 5.9.10 branch](#) with added packaging and support for DOCA IPsec plugin (check the [NVIDIA DOCA IPsec Security Gateway Application Guide](#) for more information regarding the strongSwan DOCA plugin).
4. Run autogen.sh within the strongSwan repo.
5. Run the following:

```
configure --enable-openssl --disable-random --prefix=/usr/local --  
sysconfdir=/etc --enable-systemd  
make  
make install
```

Note:

- `--enable-systemd` enables the systemd service for strongSwan present inside the GitHub repo (see step 3) at `init/systemd-starter/strongswan.service.in`.
- When building strongSwan on your own, the `openssl.cnf.mlnx` file, required for PK and RNG HW offload via OpenSSL plugin, is not installed. It must be copied over manually from github repo inside the `openssl-conf` directory. See section "[Running Strongswan Example](#)" for important notes.

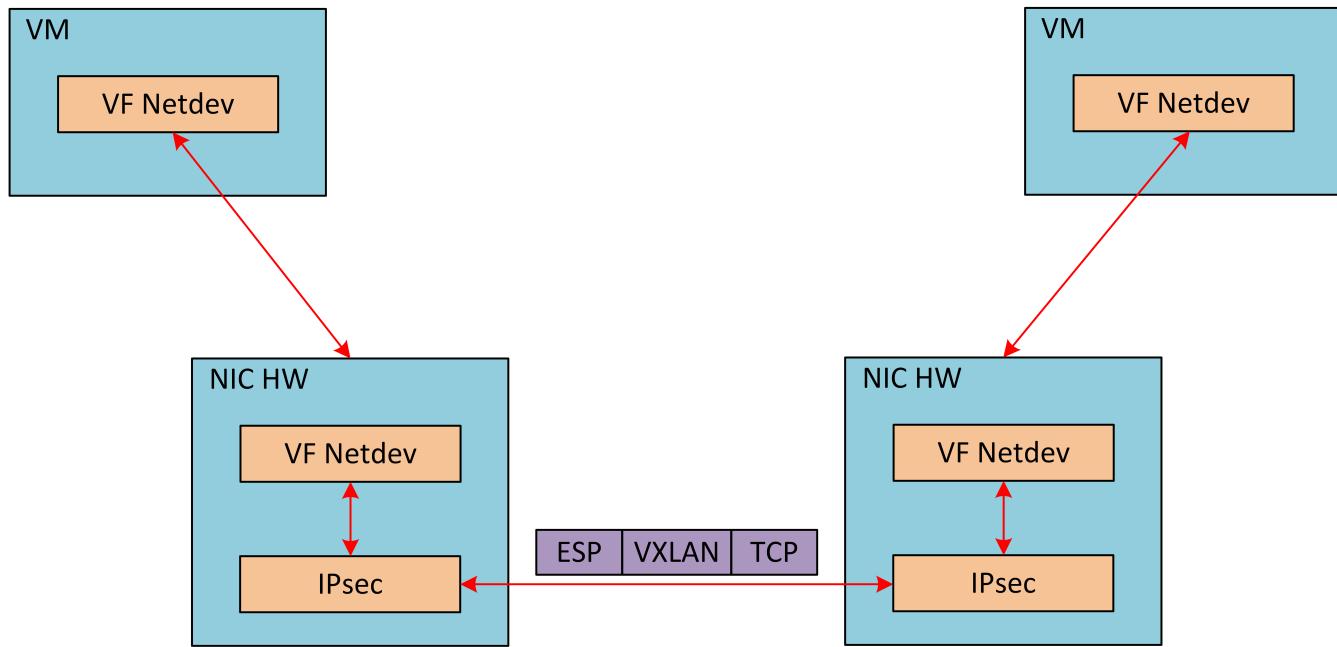
 **Note**

The `openssl.cnf.mlnx` file references PKA engine shared objects. `libpka` (version 1.3 or later) and `openssl` (version 1.1.1) must be installed for this to work.

## IPsec Packet Offload and OVS Offload

IPsec packet offload configuration works with and is transparent to OVS offload. This means all packets from OVS offload are encrypted by IPsec rules.

The following figure illustrates the interaction between IPsec packet offload and OVS VXLAN offload.



**(i) Note**

OVS offload and IPsec IPv6 do not work together.

## OVS IPsec

To start the service, run:

```
systemctl start openvswitch-ipsec.service
```

Refer to section "[Enabling IPsec Packet Offload](#)" for information to prepare the IPsec packet offload environment.

## Configuring IPsec Tunnel

For the sake of example, if you want to build an IPsec tunnel between two hosts with the following external IP addresses:

- host1 – 1.1.1.1
- host2 – 1.1.1.2

You have to first make sure host1 and host2 can ping each other via these external IPs.

This example will set up some variables on both hosts, set ip1 and ip2:

```
# ip1=1.1.1.1  
# ip2=1.1.1.2  
REP=eth5  
PF=p0
```

1. Set up OVS bridges in both hosts.

1. On Arm\_1:

```
ovs-vsctl add-br ovs-br  
ovs-vsctl add-port ovs-br $REP  
ovs-vsctl set Open_vSwitch . other_config:hw-offload=true
```

2. On Arm\_2:

```
ovs-vsctl add-br ovs-br  
ovs-vsctl add-port ovs-br $REP  
ovs-vsctl set Open_vSwitch . other_config:hw-offload=true
```

### Note

Configuring other\_config:hw-offload=true sets IPsec packet offload. Setting it to false sets software IPsec. Make sure that IPsec devlink's mode is set back to none for software IPsec.

2. Set up IPsec tunnel. Three authentication methods are possible. Follow the steps relevant for the method that works best for your environment.

 **Note**

Do not try to use more than 1 authentication method.

 **Note**

After the IPsec tunnel is set up, strongSwan configuration will be automatically done.

3. Make sure the MTU of the PF used by tunnel is at least 50 bytes larger than VXLAN-REP MTU.

1. Disable host PF as the port owner from Arm (see section "Zero-trust Mode").

Run:

```
$ mlxprivhost -d /dev/mst/mt41682_pciconf0 --disable_port_owner r
```

2. The MTU of the end points (pf0hpf in the example above) of the tunnel must be smaller than the MTU of the tunnel interfaces (p0) to account for the size of the tunnel headers. For example, you can set the MTU of P0 to 2000.

## Authentication Methods

### Using Pre-shared Key

 **Note**

The following example uses tun type=gre and dst\_port=1723. Depending on your configuration, tun type can be vxlan or geneve with dst\_port 4789 or 6081 respectively.

## Note

The following example uses ovs-br as the bridge name. However, this value can be any string you have chosen to create the bridge previously.

1. On Arm\_1, run:

```
# ovs-vsctl add-port ovs-br tun -- \
set interface tun type=gre \
options:local_ip=$ip1 \
options:remote_ip=$ip2 \
options:key=100 \
options:dst_port=1723 \
options:psk=swordfish
```

2. On Arm\_2, run:

```
# ovs-vsctl add-port ovs-br tun -- \
set interface tun type=gre \
options:local_ip=$ip2 \
options:remote_ip=$ip1 \
options:key=100 \
options:dst_port=1723 \
options:psk=swordfish
```

## Using Self-signed Certificate

1. Generate self-signed certificates in both host1 and host2, then copy the certificate of host1 to host2, and the certificate of host2 to host1.
2. Move both host1-cert.pem and host2-cert.pem to /etc/swanctl/x509/, if on Ubuntu, or /etc/strongswan/swanctl/x509/, if on CentOS.
3. Move the local private key to /etc/swanctl/private, if on Ubuntu, or /etc/strongswan/swanctl/private, if on CentOS. For example, for host1:

```
mv host1-privkey.pem /etc/swanctl/private
```

4. Set up OVS other\_config on both sides.

1. On Arm\_1:

```
# ovs-vsctl set Open_vSwitch .  
other_config:certificate=/etc/swanctl/x509/host1-cert.pem \  
other_config:private_key=/etc/swanctl/private/host1-privkey.pem
```

2. On Arm\_2:

```
# ovs-vsctl set Open_vSwitch .  
other_config:certificate=/etc/swanctl/x509/host2-cert.pem \  
other_config:private_key=/etc/swanctl/private/host2-privkey.pem
```

5. Set up the tunnel.

1. On Arm\_1:

```
# ovs-vsctl add-port ovs-br vxlanp0 -- set interface vxlanp0 type=vxlan  
options:local_ip=$ip1 \  
options:remote_ip=$ip2 options:key=100 options:dst_port=4789 \  
options:remote_cert=/etc/swanctl/x509/host2-cert.pem  
# service openvswitch-switch restart
```

2. On Arm\_2:

```
# ovs-vsctl add-port ovs-br vxlanp0 -- set interface vxlanp0 type=vxlan  
options:local_ip=$ip2 \  
options:remote_ip=$ip1 options:key=100 options:dst_port=4789 \  
options:remote_cert=/etc/swanctl/x509/host1-cert.pem  
# service openvswitch-switch restart
```

## Using CA-signed Certificate

1. For this method, you need all the certificates and the requests to be in the same directory during the certificate generating and signing. This example refers to this directory as certsworkspace.

1. On Arm\_1:

```
# ovs-pki init --force  
# cp /var/lib/openvswitch/pki/controllerca/cacert.pem  
<path_to>/certsworkspace  
# ovs-pki req -u host1  
# ovs-pki sign host1 switch
```

2. On Arm\_2:

```
# ovs-pki init --force  
# cp /var/lib/openvswitch/pki/controllerca/cacert.pem  
<path_to>/certsworkspace  
# ovs-pki req -u host2  
# ovs-pki sign host2 switch
```

2. Move both host1-cert.pem and host2-cert.pem to /etc/swanctl/x509/, if on Ubuntu, or /etc/strongswan/swanctl/x509/, if on CentOS.

3. Move the local private key to /etc/swanctl/private, if on Ubuntu, or /etc/strongswan/swanctl/private, if on CentOS. For example, for host1:

```
mv host1-privkey.pem /etc/swanctl/private
```

4. Copy cacert.pem to the x509ca directory under /etc/swanctl/x509ca/, if on Ubuntu, or /etc/strongswan/swanctl/x509ca/, if on CentOS.

5. Set up OVS other\_config on both sides.

1. On Arm\_1:

```
# ovs-vsctl set Open_vSwitch . \  
other_config:certificate=/etc/strongswan/swanctl/x509/host1.pem \  
other_config:private_key=/etc/strongswan/swanctl/private/host1-  
privkey.pem \  
other_config:ca_cert=/etc/strongswan/swanctl/x509ca/cacert.pem
```

2. On Arm\_2:

```
# ovs-vsctl set Open_vSwitch . \  
other_config:certificate=/etc/strongswan/swanctl/x509/host2.pem \  
other_config:private_key=/etc/strongswan/swanctl/private/host2-  
privkey.pem \  
other_config:ca_cert=/etc/strongswan/swanctl/x509ca/cacert.pem
```

6. Set up the tunnel:

1.

1. On Arm\_1:

```
# ovs-vsctl add-port ovs-br vxlanp0 -- set interface vxlanp0 type=vxlan  
options:local_ip=$ip1 \  
options:remote_ip=$ip2 options:key=100 options:dst_port=4789 \  
options:remote_name=host2  
#service openvswitch-switch restart
```

2. On Arm\_2:

```
# ovs-vsctl add-port ovs-br vxlanp0 -- set interface vxlanp0 type=vxlan  
options:local_ip=$ip2 \  
options:remote_ip=$ip1 options:key=100 options:dst_port=4789 \  
options:remote_name=host1  
#service openvswitch-switch restart
```

## Ensuring IPsec is Configured

Use /opt/mellanox/iproute2/sbin/ip xfrm state show. You should be able to see IPsec states with the keyword in mode packet.

## Troubleshooting

For troubleshooting information, refer to [Open vSwitch's official documentation](#).

## fTPM over OP-TEE

### Note

fTPM over OP-TEE is supported on BlueField-3 only at beta level.

The Trusted Computing Group (TCG) is responsible for the specifications governing the trusted platform module (TPM). In many systems, the TPM provides integrity measurements, health checks and authentication services.

Attributes of a TPM:

- Support for bulk (symmetric) encryption in the platform
- High quality random numbers
- Cryptographic services
- Protected persistent store for small amounts of data, sticky bits, monotonic counters, and extendible registers
- Protected pseudo-persistent store for unlimited amounts of keys and data
- Extensive choice of authorization methods to access protected keys and data
- Platform identities
- Support for platform privacy
- Signing and verifying digital signatures
- Certifying the properties of keys and data
- Auditing the usage of keys and data

With TPM 2.0., the TCG creates a library specification describing all the commands or features that could be implemented and may be necessary in servers, laptops, or embedded systems. Each platform can select the features needed and the level of security or assurance required. This flexibility allows the newest TPMs to be applied to many embedded applications.

Firmware TPM (fTPM) is implemented in protected software. The code runs on the main CPU so that a separate chip is not required. While running like any other program, the code is in a protected execution environment called a trusted execution environment (TEE) which is separate from the rest of the programs running on the CPU. By doing this, secrets (e.g., private keys perhaps needed by the TPM but should not be accessed by others) can be kept in the TEE creating a more secure environment.

### **Info**

fTPM provides similar functionality to a chip-based TPM, but does not require extra hardware. It complies with the official TCG reference

implementation of the [TPM 2.0 specification](#). The source code of this implementation is located [here](#).

## Info

fTPM fully supports [TPM2 Tools](#) and the TCG TPM2 Software Stack ([TSS](#)).

Characteristics of an fTPM:

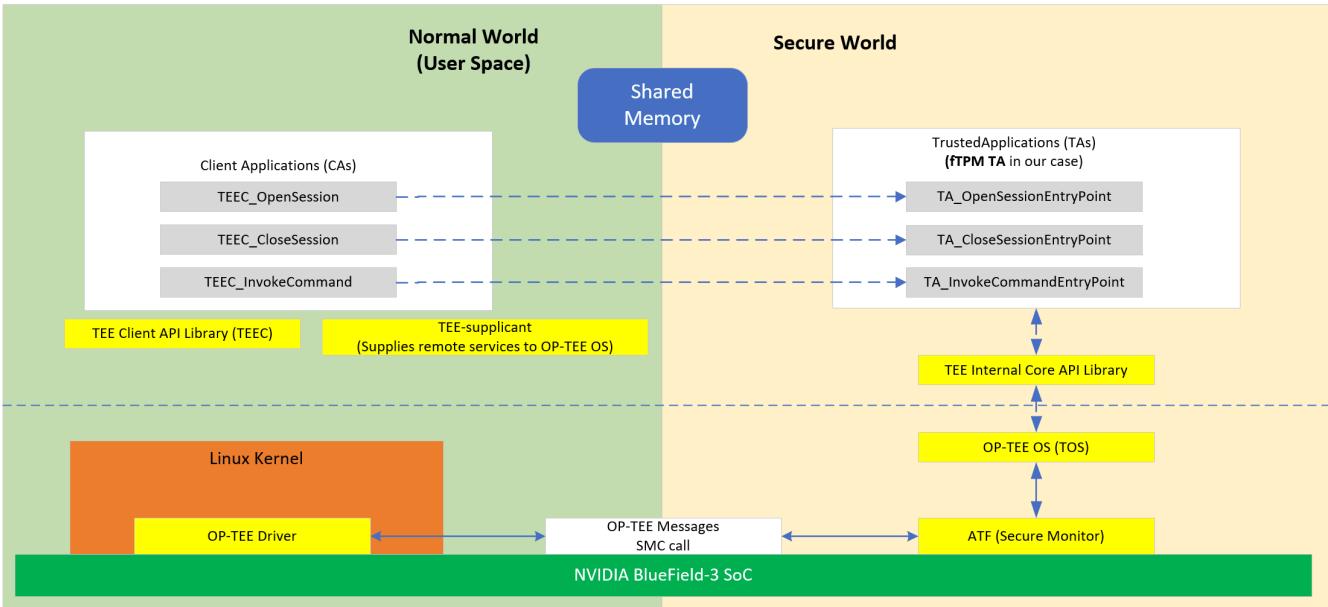
- Emulated TPM using an isolated hardware environment
- Executes in an open-source trusted execution environment (OP-TEE)
- fTPM trusted application (TA) is part of the OP-TEE binary. This allows early access on bootup, runs only in secure DRAM.

## Info

Currently, the only TA supported is fTPM.

- fTPM is not a task waiting to be woken up. It only executes when TPM primitives are forwarded to it from the user space. It is guaranteed shielded execution via the TEE OS and, when invoked via the TEE Dispatcher, runs to completion.

The fTPM TA is the only TA NVIDIA® BlueField®-3 currently supports. Any TA loaded by OP-TEE must be signed (signing done externally) and then authenticated by OP-TEE before being allowed to load and execute.

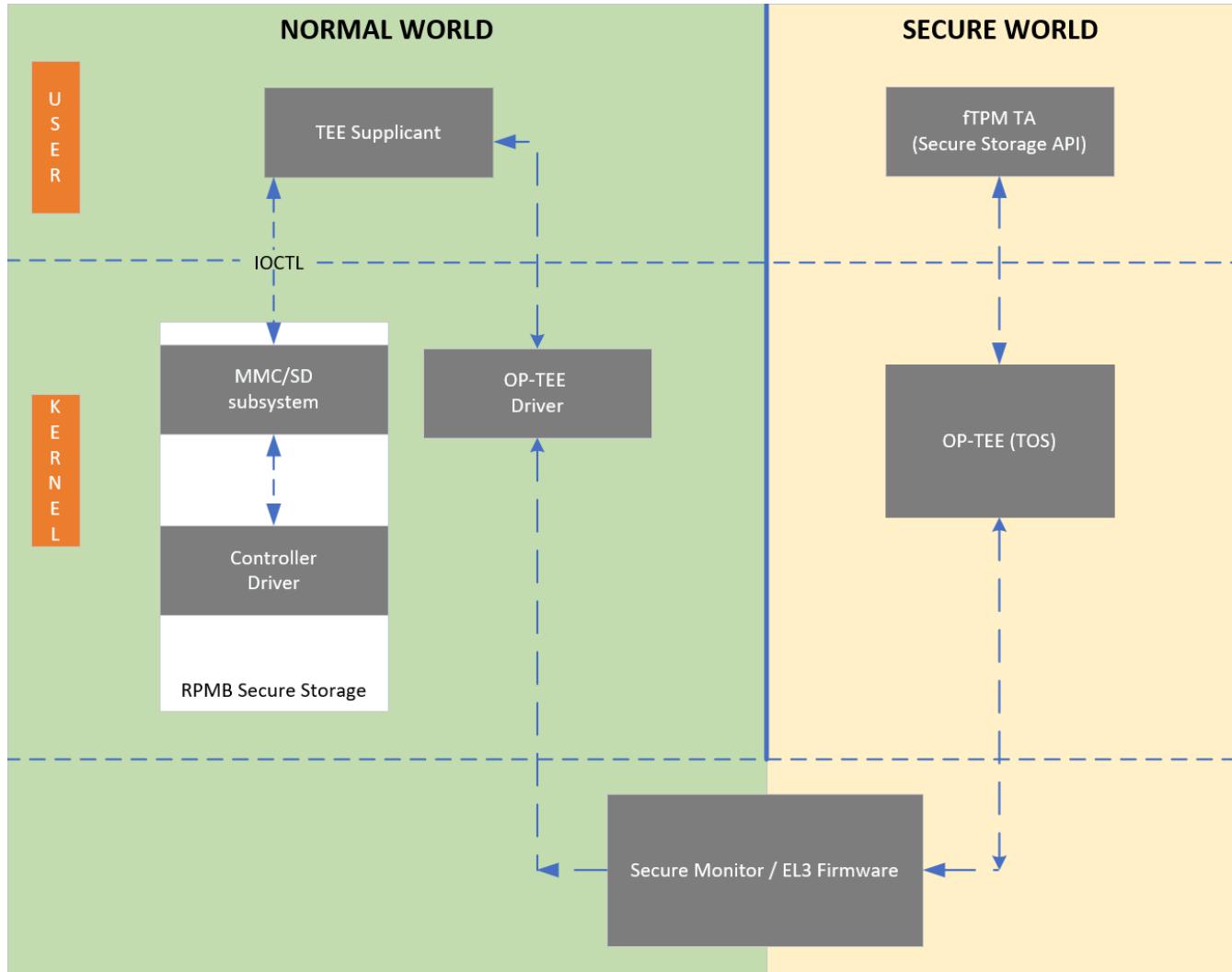


A replay-protected memory block (RPMB) is provided as a means for a system to store data to the specific memory area in an authenticated and replay-protected manner, making it readable and writable only after a successful authentication read/write accesses. The RPMB is a dedicated partition available on the eMMC, which makes it possible to store and retrieve data with integrity and authenticity support. A signed access to an RPMB is supported by first programming authentication key information to the eMMC memory (shared secret). The RPMB authentication key is programmed into the DPU at manufacturing time.

### i Info

RPMB features a 4MB partition secure storage for BlueField-3.

There is no eMMC controller driver in OP-TEE. All device operations have to go through the normal world via the TEE-suppliant daemon, which relies on the Linux kernel's ioctl interface to access the device. All writes to the RPMB are atomic, authenticated, and encrypted. The RPMB partition stores data in an authenticated, replay-protected manner, making it a perfect complement to fTPM for storing and protecting data.



## Enabling OP-TEE on BlueField-3

Enable OP-TEE in the UEFI menu:

1. ESC into the UEFI on DPU boot.
2. Navigate to Device Manager > System Configuration.
3. Check "Enable OP-TEE".
4. Save the change and reset/reboot.
5. Upon reboot OP-TEE is enabled.

**(i) Note**

OP-TEE is essentially dormant (does not have an OS scheduler) and reacts to external inputs.

## Verifying BlueField-3 is Running OP-TEE

Users can see the OP-TEE version during BlueField-3 DPU boot:

```
[Nvidia BlueField-3 rev1 BL1 V1.0
INFO: psc_supervisor_init.
INFO: psc_irq_init...
INFO: force_crs_enable=0 pcr.lock0 = 0, time = 111291
INFO: enter idle task.
NOTICE: Running as 9009D3B400ENE system
NOTICE: BL2: v2.2(release):4.5.0-16-g2bd9b06e2-dirty
NOTICE: BL2: Built : 15:43:42, Sep 7 2023
NOTICE: BL2 built for hw (ver 2)
NOTICE: # Finished initializing DDR MSS1
NOTICE: DDR POST passed.
INFO: mailbox rx: channel = 2, code = 0x43544c44
NOTICE: BL31: v2.2(release):4.5.0-16-g2bd9b06e2-dirty
NOTICE: BL31: Built : 15:43:44, Sep 7 2023
NOTICE: BL31 built for hw (ver 2), lifecycle Production

PTM:171288:2:0:6~
I/TC:
I/TC: OP-TEE version: 3.10.0-21-g450b24a (gcc version 8.3.0 (GCC)) #1 Sat Aug 26 11:54:32 UTC 2023 aarch64
I/TC: Primary CPU initializing
I/TC: Primary CPU switching to normal world boot
UEFI firmware (version BlueField:4.5.0-16-g0e7fa9c192-BId0 built at 20:53:10 on Sep 6 2023)
```

The following indicators should all be present if fTPM over OP-TEE is enabled:

- Check "dmesg" for the OP-TEE driver initializing

```
root@localhost ~]# dmesg | grep tee
[ 5.646578] optee: probing for conduit method.
[ 5.653282] optee: revision 3.10 (450b24ac)
[ 5.653991] optee: initialized driver
```

- Verify that the following kernel modules are loaded (running):

```
[root@localhost ~]# lsmod | grep tee
tpm_ftpm_tee      16384  0
optee            49152  1
```

tee 49152 3 optee,tpm\_ftpm\_tee

- Verify that the proper devices are created/available (4 in total):

```
[root@localhost ~]# ls -l /dev/tee*
crw----- 1 root root 234, 0 Sep 8 18:24 /dev/tee0
crw----- 1 root root 234, 16 Sep 8 18:24 /dev/teepriv0
```

```
[root@localhost ~]# ls -l /dev/tpm*
crw-rw--- 1 tss root 10, 224 Sep 8 18:24 /dev/tpm0
crw-rw--- 1 tss tss 252, 65536 Sep 8 18:24 /dev/tpmrm0
```

- Verify that the required processes are running (3 in total):

```
[root@localhost ~]# ps axu | grep tee
root      707  0.0  0.0 76208 1372 ?      Ssl 14:42  0:00 /usr/sbin/tee-
suplicant
root      715  0.0  0.0    0   0 ?      I< 14:42  0:00 [optee_bus_scan]
```

```
[root@localhost ~]# ps axu | grep tpm
root      124  0.0  0.0    0   0 ?      I< 18:24  0:00 [tpm_dev_wq]
```

## QoS Configuration



To learn more about port QoS configuration, refer to [this](#) community post.



### Warning

When working in Embedded Host mode, using `mlnx_qos` on both the host and Arm will result with undefined behavior. Users must only use `mlnx_qos` from the Arm. After changing the QoS settings from Arm, users must restart the `mlx5` driver on host.

### Note

When configuring QoS using DCBX, the `lldpad` service from the DPU side must be disabled if the configurations are not done using tools other than `lldpad`.

This section explains how to configure QoS group and settings using devlink located under `/opt/mellanox/iproute2/sbin/`. It is applicable to host PF/VF and Arm side SFs. The following uses VF as example.

The settings of a QoS group include creating/deleting a QoS group and modifying its `tx_max` and `tx_share` values. The settings of VF QoS include modifying its `tx_max` and `tx_share` values, assigning a VF to a QoS group, and unassigning a VF from a QoS group. This section focuses on the configuration syntax.

Please refer to section "Limit and Bandwidth Share Per VF" in the MLNX\_OFED User Manual for detailed explanation on vPort QoS behaviors.

## devlink port function rate add

	devlink port function rate add <DEV>/<GROUP_NAME> Adds a QoS group.	
Syntax Description	DEV/GROUP_NAME	Specifies group name in string format
Example	<p>This command adds a new QoS group named <code>12_group</code> under device <code>pci/0000:03:00.0</code>:</p> <pre>devlink port function rate add pci/0000:03:00.0/12_group</pre>	

Notes	
-------	--

## devlink port function rate del

	devlink port function rate del <DEV>/<GROUP_NAME> Deletes a QoS group.	
Syntax Description	DEV/GROUP_NAME	Specifies group name in string format
Example	<p>This command deletes QoS group 12_group from device pci/0000:03:00.0:</p> <pre>devlink port function rate del pci/0000:03:00.0/12_group</pre>	
Notes		

## devlink port function rate set tx\_max tx\_share

	devlink port function rate set {<DEV>/<GROUP_NAME>   <DEV>/<PORT_INDEX>} tx_max <TX_MAX> [tx_share <TX_SHARE>] Sets tx_max and tx_share for QoS group or devlink port.	
Syntax Description	DEV/GROUP_NAME	Specifies the group name to operate on
	DEV/PORT_INDEX	Specifies the devlink port to operate on
	TX_MAX	tx_max bandwidth in MB/s
	TX_SHARE	tx_share bandwidth in MB/s
Example	<p>This command sets tx_max to 2000MB/s and tx_share to 500MB/s for the 12_group QoS group:</p> <pre>devlink port function rate set pci/0000:03:00.0/12_group tx_max 2000MBps tx_share 500MBps</pre> <p>This command sets tx_max to 2000MB/s and tx_share to 500MB/s for the VF represented by port index 196609:</p> <pre>devlink port function rate set pci/0000:03:00.0/196609 tx_max 200MBps tx_share 50MBps</pre> <p>This command displays a mapping between VF devlink ports and netdev names:</p>	

	<pre>\$ devlink port</pre> <p>In the output of this command, VFs are indicated by flavour pcivf.</p>
Notes	

## devlink port function rate set parent

	devlink port function rate set <DEV>/<PORT_INDEX> {parent <PARENT_GROUP_NAME>} Assigns devlink port to a QoS group.	
Syntax Description	DEV/PORT_INDEX	Specifies the devlink port to operate on
	PARENT_GROUP_NAME	parent group name in string format
Example	This command assigns this function to the QoS group 12_group: <pre>devlink port function rate set pci/0000:03:00.0/196609 parent 12_group</pre>	
Notes		

## devlink port function rate set noparent

	devlink port function rate set <DEV>/<PORT_INDEX> noparent Ungroups a devlink port.	
Syntax Description	DEV/PORT_INDEX	Specifies the devlink port to operate on
Example	This command ungroups this function: <pre>devlink port function rate set pci/0000:03:00.0/196609 noparent</pre>	
Notes		

## devlink port function rate show

	devlink port function rate show [<DEV>/<GROUP_NAME>   <DEV>/<PORT_INDEX>] Displays QoS information QoS group or devlink port.
--	--

Syntax Description	DEV/GROUP_NAME	Specifies the group name to display
	DEV/PORT_INDEX	Specifies the devlink port to display
Example		<p>This command displays the QoS info of all QoS groups and devlink ports on the system:</p> <pre>devlink port function rate show pci/0000:03:00.0/12_group type node tx_max 2000MBps tx_share 500MBps pci/0000:03:00.0/196609 type leaf tx_max 200MBps tx_share 50MBps parent 12_group</pre> <p>This command displays QoS info of 12_group:</p> <pre>devlink port function rate show pci/0000:03:00.0/12_group pci/0000:03:00.0/12_group type node tx_max 2000MBps tx_share 500MBps</pre>
Notes		If a QoS group name or devlink port are not specified, all QoS groups and devlink ports are displayed.

## Virtio-net Emulated Devices

For information on virtio-net emulation, please refer to [NVIDIA BlueField Virtio-net documentation](#).

## Shared RQ Mode

When creating 1 send queue (SQ) and 1 receive queue (RQ), each representor consumes ~3MB memory per single channel. Scaling this to the desired 1024 representors (SFs and/or VFs) would require ~3GB worth of memory for single channel. A major chunk of the 3MB is contributed by RQ allocation (receive buffers and SKBs). Therefore, to make efficient use of memory, shared RQ mode is implemented so PF/VF/SF representors share receive queues owned by the uplink representor.

The feature is enabled by default. To disable it:

1. Edit the field ALLOW\_SHARED\_RQ in /etc/mellanox/mlnx-bf.conf as follows:

```
ALLOW_SHARED_RQ="no"
```

2. Restart the driver. Run:

```
/etc/init.d/openibd restart
```

To connect from the host to BlueField in shared RQ mode, please refer to section [Verifying Connection from Host to BlueField](#).

 **Note**

PF/VF representor to PF/VF communication on the host is not possible.

The following behavior is observed in shared RQ mode:

- It is expected to see a 0 in the rx\_bytes and rx\_packets and valid vport\_rx\_packets and vport\_rx\_bytes after running traffic. Example output:

```
# ethtool -S pf0hpf
NIC statistics:
rx_packets: 0
rx_bytes: 0
tx_packets: 66946
tx_bytes: 8786869
vport_rx_packets: 546093
vport_rx_bytes: 321100036
vport_tx_packets: 549449
vport_tx_bytes: 321679548
```

- Ethtool usage – in this mode, it is not possible to change/set the ring or coalesce parameters for the RX side using ethtool. Changing channels also only affects the TX side.

---

# Troubleshooting and How-Tos

- [NVIDIA BlueField Reset and Reboot Procedures](#)
- [RShim Troubleshooting and How-Tos](#)
- [Connectivity Troubleshooting](#)
- [Performance Troubleshooting](#)
- [PCIe Troubleshooting and How-Tos](#)
- [SR-IOV Troubleshooting](#)
- [eSwitch Troubleshooting](#)
- [Isolated Mode Troubleshooting and How-Tos](#)
- [General Troubleshooting](#)
- [Installation Troubleshooting and How-Tos](#)

## NVIDIA BlueField Reset and Reboot Procedures

### BlueField System Reboot

This section describes the necessary operations to load new NIC firmware, following NVIDIA® BlueField® NIC firmware update. This procedure deprecates the need for full server power cycle.

The following steps are executed in the BlueField OS:

1. Issue a query command to ascertain whether BlueField system reboot is supported by your environment:

```
mlxfwreset -d 03:00.0 q
```

If the output includes the following lines, proceed to step 2:

```
3: Driver restart and PCI reset      -Supported (default)
```

```
...
```

```
1: Driver is the owner      -Supported (default)
```

 **Note**

If it says Not Supported instead, then proceed to the instructions under section "[BlueField System-level Reset](#)".

2. Issue a BlueField system reboot:

```
mlxfwreset -d 03:00.0 -y -l 3 --sync 1 r
```

## BlueField System-level Reset

This section describes the necessary system-level reset following firmware configuration changes.

The two methods for performing BlueField system-level reset are described in the following subsection. Each method is designed to support different host platforms, in which host OS/CPUs and PCIe slots may have uniform or separate power control.

In each approach, the procedure can be performed through various methods, according to resource availability and support in the user's environment.

# System-level Reset for BlueField in DPU Mode with Minimal Host OS Downtime

The following is the high-level flow of the procedure:

1. Graceful shutdown of BlueField Arm cores.
2. Query BlueField state to affirm shutdown reached.

 **Info**

In systems with multiple BlueField networking platforms, repeat steps 1 and 2 for all devices before proceeding.

3. Warm reboot the server.

Step by step process:

1. Graceful shutdown of BlueField Arm cores.

 **Info**

This operation is expected to finish within 15 seconds.

Options:

- From the BlueField OS:

```
shutdown -h now
```

Or:

```
mlxfwreset -d /dev/mst/mt*pciconf0 -l 1 -t 4 --sync 0 r
```

- From the host OS:

 **Info**

Not relevant when the BlueField is operating in Zero-Trust Mode.

```
mlxfwreset -d <mst-device> -l 1 -t 4 r
```

- Using the BlueField BMC:

```
ipmitool -C 17 -I lanplus -H <bmc_ip> -U root -P <password> power soft
```

Or using Redfish (BlueField-3 and above):

```
curl -k -u root:<password> -H "Content-Type: application/json" -X POST  
https://<bmc_ip>/redfish/v1/Systems/Bluefield/Actions/ComputerSystem.Reset -d  
'{"ResetType": "GracefulShutdown"}'
```

## 2. Query BlueField state. Options:

- From the host OS:

 **Info**

Not relevant when the BlueField is operating in Zero-Trust Mode.

```
echo DISPLAY_LEVEL 2 > /dev/rshim0/misc  
cat /dev/rshim0/misc
```

Expected output:

```
INFO[BL31]: System Off
```

- Utilizing the BlueField BMC:

```
ipmitool -C 17 -I lanplus -H <bmc_ip> -U root -P <password> raw 0x32 0xA3
```

Expected output: 06.

### 3. Warm reboot the server:

- From the host OS:

```
mlxfwreset -d <mst-device> -l 4 r
```

#### Note

If multiple DPUs are present in the host, this command must run only once. In this case, the MST device can be of any of the DPUs for which the reset is necessary and participated in step 1.

Or:

```
reboot
```

#### Note

For external hosts which do not toggle PERST# in their standard reboot command, use the `mlxfwreset` option.

## System-level Reset for BlueField in DPU Mode where Host is Down Throughout the Process

This procedure is only relevant to server platforms that have separate power control for PCIe slot and CPUs in which the BlueField is provided power while host OS/CPPUs may be in shutdown or similar standby state.

The following is the high-level flow of the procedure:

1. Graceful shutdown of host OS or similar CPU standby.
2. Graceful shutdown of BlueField Arm cores.
3. Query BlueField state to affirm shutdown reached.
4. Full BlueField Reset
5. Query BlueField state to affirm operational state reached

### Info

In systems with multiple BlueField networking platforms, repeat steps 1 through 5 for all devices before proceeding.

6. Power on the server.

Step by step process:

1. Graceful shutdown of host OS by any means preferable.

## 2. Graceful shutdown of BlueField Arm cores.

### Info

This step normally takes up to 15 seconds to complete.

- From the BlueField OS:

```
shutdown -h now
```

- Utilizing the BlueField BMC:

- Using IPMI:

```
ipmitool -C 17 -I lanplus -H <bmc_ip> -U root -P <password> power soft
```

- Using Redfish (for BlueField-3 and above):

```
curl -k -u root:<password> -H "Content-Type: application/json" -X POST https://<bmc_ip>/redfish/v1/Systems/Bluefield/Actions/ComputerSystem.Reset -d '{"ResetType": "GracefulShutdown"}'
```

## 3. Query the BlueField's state utilizing the BlueField BMC:

```
ipmitool -C 17 -I lanplus -H <bmc_ip> -U root -P <password> raw 0x32 0xA3
```

Expected output: 06.

## 4. Perform BlueField hard reset utilizing the BlueField BMC:

### Info

This step takes up to 2 minutes to complete .

- o Using IPMI:

```
ipmitool -C 17 -I lanplus -H <bmc_ip> -U root -P <password> power cycle
```

- o Using Redfish (for BlueField-3 and above):

```
curl -k -u root:<password> -H "Content-Type: application/json" -X POST  
https://<bmc_ip>/redfish/v1/Systems/Bluefield/Actions/ComputerSystem.Reset -d  
'{"ResetType" : "PowerCycle"}'
```

## 5. Query BlueField operational state u tilizing the BlueField BMC :

### Info

At this point, the BlueField is expected to b e operational .

```
ipmitool -C 17 -I lanplus -H <bmc_ip> -U root -P <password> raw 0x32 0xA3
```

Expected output: 05.

## 6. Power on/boot up the host OS.

# System-level Reset for BlueField in NIC Mode

Perform warm reboot of the host OS:

```
mlxfwreset -d <mst-device> -l 4 r
```

Or:

```
reboot
```

 **Note**

For external hosts which do not toggle PERST# in their standard reboot command, use the `mlxfwreset` option.

## RShim Troubleshooting and How-Tos

### Another backend already attached

Several generations of BlueField DPs are equipped with a USB interface in which RShim can be routed, via USB cable, to an external host running Linux and the RShim driver.

In this case, typically following a system reboot, the RShim over USB prevails and the DPU host reports RShim status as "another backend already attached". This is correct behavior, since there can only be one RShim backend active at any given time. However, this means that the DPU host does not own RShim access.

To reclaim RShim ownership safely:

1. Stop the RShim driver on the remote Linux. Run:

```
systemctl stop rshim  
systemctl disable rshim
```

2. Restart RShim on the DPU host. Run:

```
systemctl enable rshim  
systemctl start rshim
```

The "another backend already attached" scenario can also be attributed to the RShim backend being owned by the BMC in DPUs with integrated BMC. This is elaborated on further down on this page.

## RShim driver not loading

Verify whether your DPU features an integrated BMC or not. Run:

```
# sudo lsusb | $(sudo lsusb -d 15b3: | head -1 | awk '{print $1}') -vvv | grep  
"Product Name"
```

Example output for DPU **with integrated BMC**:

```
Product Name: BlueField-2 DPU 25GbE Dual-Port SFP56, integrated BMC, Crypto  
and Secure Boot Enabled, 16GB on-board DDR, 1GbE OOB management, Tall  
Bracket, FHHL
```

If your DPU has an integrated BMC, refer to [RShim driver not loading on host with integrated BMC](#).

If your DPU does not have an integrated BMC, refer to [RShim driver not loading on host on DPU without integrated BMC](#).

## RShim driver not loading on DPU with integrated BMC

### RShim driver not loading on host

1. Access the BMC via the RJ45 management port of the DPU.
2. Delete RShim on the BMC:

```
systemctl stop rshim  
systemctl disable rshim
```

3. Enable RShim on the host:

```
systemctl enable rshim  
systemctl start rshim
```

4. Restart RShim service. Run:

```
sudo systemctl restart rshim
```

If RShim service does not launch automatically, run:

```
sudo systemctl status rshim
```

This command is expected to display "active (running)".

5. Display the current setting. Run:

```
# cat /dev/rshim<N>/misc | grep DEV_NAME  
DEV_NAME pcie-04:00.2 (ro)
```

This output indicates that the RShim service is ready to use.

## RShim driver not loading on BMC

1. Verify that the RShim service is not running on host. Run:

```
systemctl status rshim
```

If the output is active, then it may be presumed that the host has ownership of the RShim.

2. Delete RShim on the host. Run:

```
systemctl stop rshim  
systemctl disable rshim
```

3. Enable RShim on the BMC. Run:

```
systemctl enable rshim  
systemctl start rshim
```

4. Display the current setting. Run:

```
# cat /dev/rshim<N>/misc | grep DEV_NAME  
DEV_NAME usb-1.0
```

This output indicates that the RShim service is ready to use.

## RShim driver not loading on host on DPU without integrated BMC

1. Download the suitable DEB/RPM for RShim (management interface for DPU from the host) driver.
2. Reinstall RShim package on the host.

- For Ubuntu/Debian, run:

```
sudo dpkg --force-all -i rshim-<version>.deb
```

- For RHEL/CentOS, run:

```
sudo rpm -Uhv rshim-<version>.rpm
```

3. Restart RShim service. Run:

```
sudo systemctl restart rshim
```

If RShim service does not launch automatically, run:

```
sudo systemctl status rshim
```

This command is expected to display "active (running)".

4. Display the current setting. Run:

```
# cat /dev/rshim<N>/misc | grep DEV_NAME  
DEV_NAME pcie-04:00.2 (ro)
```

This output indicates that the RShim service is ready to use.

## Change ownership of RShim from NIC BMC to host

1. Verify that your card has BMC. Run the following on the host:

```
# sudo sudo lspci -s $(sudo lspci -d 15b3: | head -1 | awk '{print $1}') -vvv |grep  
"Product Name"  
Product Name: BlueField-2 DPU 25GbE Dual-Port SFP56, integrated BMC,  
Crypto and Secure Boot Enabled, 16GB on-board DDR, 1GbE OOB  
management, Tall Bracket, FHHL
```

The product name is supposed to show "integrated BMC".

2. Access the BMC via the RJ45 management port of the DPU.

3. Delete RShim on the BMC:

```
systemctl stop rshim
```

```
systemctl disable rshim
```

4. Enable RShim on the host:

```
systemctl enable rshim  
systemctl start rshim
```

5. Restart RShim service. Run:

```
sudo systemctl restart rshim
```

If RShim service does not launch automatically, run:

```
sudo systemctl status rshim
```

This command is expected to display "active (running)".

6. Display the current setting. Run:

```
# cat /dev/rshim<N>/misc | grep DEV_NAME  
DEV_NAME pcie-04:00.2 (ro)
```

This output indicates that the RShim service is ready to use.

## How to support multiple DPUs on the host

For more information, refer to section "[RShim Multiple Board Support](#)".

## BFB installation monitoring

The BFB installation flow can be traced using various interfaces:

- From the host:
  - RShim console (/dev/rshim0/console)

- RShim log buffer (/dev/rshim0/misc); also included in bfb-install's output
  - UART console (/dev/ttyUSBO)
- From the BMC console:
    - SSH to the BMC and run obmc-console-client

 **Info**

Additional information about BMC interfaces is available in  
[BMC software documentation](#)

- From the DPU:
  - /root/<OS>.installation.log available on the DPU OS after installation

## Connectivity Troubleshooting

### Connection (ssh, screen console) to the BlueField is lost

The UART cable in the Accessories Kit (OPN: MBF20-DKIT) can be used to connect to the DPU console and identify the stage at which BlueField is hanging.

Follow this procedure:

1. Connect the UART cable to a USB socket, and find it in your USB devices.

```
sudo lsusb
Bus 002 Device 003: ID 0403:6001 Future Technology Devices International,
Ltd FT232 Serial (UART) IC
```

 **Note**

For more information on the UART connectivity, please refer to the [DPU's hardware user guide](#) under Supported Interfaces > Interfaces Detailed Description > NC-SI Management Interface.

 **Info**

It is good practice to connect the other end of the NC-SI cable to a different host than the one on which the BlueField DPU is installed.

2. Install the minicom application.

- For CentOS/RHEL:

```
sudo yum install minicom -y
```

- For Ubuntu/Debian:

```
sudo apt-get install minicom
```

3. Open the minicom application.

```
sudo minicom -s -c on
```

4. Go to "Serial port setup"

5. Enter "F" to change "Hardware Flow control" to NO

6. Enter "A" and change to /dev/ttyUSB0 and press Enter

7. Press ESC.

8. Type on "Save setup as dfl"

9. Exit minicom by pressing Ctrl + a + z.

```
+-----+
| A - Serial Device : /dev/ttyUSB0 |
| |
| C - Callin Program : |
| D - Callout Program : |
| E - Bps/Par/Bits : 115200 8N1 |
| F - Hardware Flow Control : No |
| G - Software Flow Control : No |
| |
| Change which setting? |
+-----+
```

## Driver not loading in host server

What this looks like in dmsg:

```
[275604.216789] mlx5_core 0000:af:00.1: 63.008 Gb/s available PCIe bandwidth,
limited by 8 GT/s x8 link at 0000:ae:00.0 (capable of 126.024 Gb/s with 16 GT/s x8
link)
[275624.187596] mlx5_core 0000:af:00.1: wait_fw_init:316:(pid 943): Waiting for FW
initialization, timeout abort in 100s
[275644.152994] mlx5_core 0000:af:00.1: wait_fw_init:316:(pid 943): Waiting for FW
initialization, timeout abort in 79s
[275664.118404] mlx5_core 0000:af:00.1: wait_fw_init:316:(pid 943): Waiting for FW
initialization, timeout abort in 59s
[275684.083806] mlx5_core 0000:af:00.1: wait_fw_init:316:(pid 943): Waiting for FW
initialization, timeout abort in 39s
[275704.049211] mlx5_core 0000:af:00.1: wait_fw_init:316:(pid 943): Waiting for FW
initialization, timeout abort in 19s
[275723.954752] mlx5_core 0000:af:00.1: mlx5_function_setup:1237:(pid 943):
Firmware over 120000 MS in pre-initializing state, aborting
[275723.968261] mlx5_core 0000:af:00.1: init_one:1813:(pid 943): mlx5_load_one
failed with error code -16
```

[275723.978578] mlx5\_core: probe of 0000:af:00.1 failed with error -16

The driver on the host server is dependent on the Arm side. If the driver on Arm is up, then the driver on the host server will also be up.

Please verify that:

- The driver is loaded in the BlueField (Arm)
- The Arm is booted into OS
- The Arm is not in UEFI Boot Menu
- The Arm is not hanged

Then:

1. Perform a graceful shutdown and a power cycle on the host server.
2. If the problem persists, reset nvconfig (`sudo mlxconfig -d /dev/mst/<device> -y reset`) and perform a BlueField system reboot.

 **Note**

If your BlueField is VPI capable, please be aware that this configuration will reset the link type on the network ports to IB. To change the network port's link type to Ethernet, run:

```
sudo mlxconfig -d <device> s LINK_TYPE_P1=2  
LINK_TYPE_P2=2
```

This configuration change requires performing a BlueField system reboot.

3. If this problem still persists, please make sure to install the latest bfb image and then restart the driver in host server. Please refer to "Upgrading NVIDIA BlueField

[DPU Software](#)" for more information.

## No connectivity between network interfaces of source host to destination device

Verify that the bridge is configured properly on the Arm side.

The following is an example for default configuration:

```
$ sudo ovs-vsctl show
f6740bfb-0312-4cd8-88c0-a9680430924f
Bridge ovsbr1
Port pf0sf0
Interface pf0sf0
Port p0
Interface p0
Port pf0hpf
Interface pf0hpf
Port ovsbr1
Interface ovsbr1
type: internal
Bridge ovsbr2
Port p1
Interface p1
Port pf1sf0
Interface pf1sf0
Port pf1hpf
Interface pf1hpf
Port ovsbr2
Interface ovsbr2
type: internal
ovs_version: "2.14.1"
```

If no bridge configuration exists, please refer to "[Virtual Switch on BlueField](#)".

## Uplink in Arm down while uplink in host server up

Please check that the cables are connected properly into the network ports of the DPU and the peer device.

# Performance Troubleshooting

## Degradation in performance

Degradation in performance indicates that openvswitch may not be offloaded.

Verify offload state. Run:

```
# ovs-vsctl get Open_vSwitch . other_config:hw-offload
```

- If hw-offload = true – Fast Pass is configured (desired result)
- If hw-offload = false – Slow Pass is configured

If hw-offload = false :

- For RHEL/CentOS, run:

```
# ovs-vsctl set Open_vSwitch . other_config:hw-offload=true;
# systemctl restart openvswitch;
# systemctl enable openvswitch;
```

- Ubuntu/Debian:

```
# ovs-vsctl set Open_vSwitch . other_config:hw-offload=true;
# /etc/init.d/openvswitch-switch restart
```

# PCIe Troubleshooting and How-Tos

## Insufficient power on the PCIe slot error

If the error "insufficient power on the PCIe slot" is printed in dmsg, please refer to the Specifications section of your [hardware user guide](#) and make sure that you are providing your DPU the correct amount of power.

To verify how much power is supported on your host's PCIe slots, run the command `lspci -vv | grep PowerLimit`. For example:

```
# lspci -vv | grep PowerLimit
Slot #6, PowerLimit 75.000W; Interlock- NoCompl-
Slot #1, PowerLimit 75.000W; Interlock- NoCompl-
Slot #4, PowerLimit 75.000W; Interlock- NoCompl-
```

### Note

Be aware that this command is not supported by all host vendors/types.

## HowTo update PCIe device description

`lspci` may not present the full description for the NVIDIA PCIe devices connected to your host. For example:

```
# lspci | grep -i Mellanox
a3:00.0 Infiniband controller: Mellanox Technologies Device a2d6 (rev 01)
a3:00.1 Infiniband controller: Mellanox Technologies Device a2d6 (rev 01)
a3:00.2 DMA controller: Mellanox Technologies Device c2d3 (rev 01)
```

Please run the following command:

```
# update-pciids
```

Now you should be able to see the full description for those devices. For example:

```
# lspci | grep -i Mellanox
a3:00.0 Infiniband controller: Mellanox Technologies MT42822 BlueField-2
integrated ConnectX-6 Dx network controller (rev 01)
a3:00.1 Infiniband controller: Mellanox Technologies MT42822 BlueField-2
integrated ConnectX-6 Dx network controller (rev 01)
a3:00.2 DMA controller: Mellanox Technologies MT42822 BlueField-2 SoC
Management Interface (rev 01)
```

## HowTo handle two BlueField DPU devices in the same server

Please refer to section "[Multi-board Management Example](#)".

## SR-IOV Troubleshooting

### Unable to create VFs

1. Please make sure that SR-IOV is enabled in BIOS.
2. Verify SRIOV\_EN is true and NUM\_OF\_VFS bigger than 1. Run:

```
# mlxconfig -d /dev/mst/mt41686_pciconf0 -e q |grep -i
"SRIOV_EN\|num_of_vf"
Configurations: Default Current Next Boot
* NUM_OF_VFS 16 16 16
* SRIOV_EN True(1) True(1) True(1)
```

3. Verify that GRUB\_CMDLINE\_LINUX="iommu=pt intel\_iommu=on pci=assign-busses".

### No traffic between VF to external host

1. Please verify creation of representors for VFs inside the Bluefield DPU. Run:

```
# /opt/mellanox/iproute2/sbin/rdma link |grep -i up
```

```
...
link mlx5_0/2 state ACTIVE physical_state LINK_UP netdev pf0vf0
...
```

2. Make sure the representors of the VFs are added to the bridge. Run:

```
# ovs-vsctl add-port <bridge_name> pf0vf0
```

3. Verify VF configuration. Run:

```
$ ovs-vsctl show
bb993992-7930-4dd2-bc14-73514854b024
Bridge ovsbr1
Port pf0vf0
Interface pf0vf0
type: internal
Port pf0hp0
Interface pf0hp0
Port pf0sf0
Interface pf0sf0
Port p0
Interface p0
Bridge ovsbr2
Port ovsbr2
Interface ovsbr2
type: internal
Port pf1sf0
Interface pf1sf0
Port p1
Interface p1
Port pf1hp0
Interface pf1hp0
ovs_version: "2.14.1"
```

# eSwitch Troubleshooting

## Unable to configure legacy mode

To set devlink to "Legacy" mode in BlueField, run:

```
# devlink dev eswitch set pci/0000:03:00.0 mode legacy  
# devlink dev eswitch set pci/0000:03:00.1 mode legacy
```

Please verify that:

- No virtual functions are open. To verify if VFs are configured, run:

```
# /opt/mellanox/iproute2/sbin/rdma link | grep -i up  
link mlx5_0/2 state ACTIVE physical_state LINK_UP netdev pf0vf0  
link mlx5_1/2 state ACTIVE physical_state LINK_UP netdev pf1vf0
```

If any VFs are configured, destroy them by running:

```
# echo 0 > /sys/class/infiniband/mlx5_0/device/mlx5_num_vfs  
# echo 0 > /sys/class/infiniband/mlx5_1/device/mlx5_num_vfs
```

- If any SFs are configured, delete them by running:

```
/sbin/mlnx-sf -a delete --sfindex <SF Index>
```

### Note

You may retrieve the <SF Index> of the currently installed SFs by running:

```
# mlnx-sf -a show
```

SF Index: pci/0000:03:00.0/229408  
Parent PCI dev: 0000:03:00.0  
Representor netdev: en3f0pf0sf0  
Function HWADDR: 02:61:f6:21:32:8c  
Auxiliary device: mlx5\_core.sf.2  
netdev: enp3s0f0s0  
RDMA dev: mlx5\_2

SF Index: pci/0000:03:00.1/294944  
Parent PCI dev: 0000:03:00.1  
Representor netdev: en3f1pf1sf0  
Function HWADDR: 02:30:13:6a:2d:2c  
Auxiliary device: mlx5\_core.sf.3  
netdev: enp3s0f1s0  
RDMA dev: mlx5\_3

Pay attention to the SF Index values. For example:

```
/sbin/mlnx-sf -a delete --sfindex pci/0000:03:00.0/229408  
/sbin/mlnx-sf -a delete --sfindex pci/0000:03:00.1/294944
```

If the error "Error: mlx5\_core: Can't change mode when flows are configured" is encountered while trying to configure legacy mode, please make sure that

1. Any configured SFs are deleted (see above for commands).
2. Shut down the links of all interfaces, delete any ip xfrm rules, delete any configured OVS flows, and stop openvswitch service. Run:

```
ip link set dev p0 down  
ip link set dev p1 down  
ip link set dev pf0hp0 down  
ip link set dev pf1hp0 down  
ip link set dev vxlan_sys_4789 down
```

```
ip x s f;  
ip x p f;  
  
tc filter del dev p0 ingress  
tc filter del dev p1 ingress  
tc qdisc show dev p0  
tc qdisc show dev p1  
tc qdisc del dev p0 ingress  
tc qdisc del dev p1 ingress  
tc qdisc show dev p0  
tc qdisc show dev p1  
  
systemctl stop openvswitch-switch
```

## Arm appears as two interfaces

What this looks like:

```
# sudo /opt/mellanox/iproute2/sbin/rdma link  
link mlx5_0/1 state ACTIVE physical_state LINK_UP netdev p0  
link mlx5_1/1 state ACTIVE physical_state LINK_UP netdev p1
```

- Check if you are working in legacy mode.

```
# devlink dev eswitch show pci/0000:03:00.<0|1>
```

If the following line is printed, this means that you are working in legacy mode:

```
pci/0000:03:00.<0|1>: mode legacy inline-mode none encap enable
```

Please configure the DPU to work in switchdev mode. Run:

```
devlink dev eswitch set pci/0000:03:00.<0|1> mode switchdev
```

- Check if you are working in separated mode:

```
# mlxconfig -d /dev/mst/mt41686_pciconf0 q | grep -i cpu  
* INTERNAL_CPU_MODEL SEPERATED_HOST(0)
```

Please configure the DPU to work in embedded mode. Run:

```
devlink dev eswitch set pci/0000:03:00.<0|1> mode switchdev
```

## Isolated Mode Troubleshooting and How-Tos

### Unable to burn FW from host server

Please verify that you are not in running in isolated mode. Run:

```
$ sudo mlxprivhost -d /dev/mst/mt41686_pciconf0 q  
Current device configurations:
```

```
-----  
level : PRIVILEGED
```

```
...
```

By default, BlueField operates in privileged mode. Please refer to "[Modes of Operation](#)" for more information.

## General Troubleshooting

### Server unable to find the DPU

- Ensure that the DPU is placed correctly
- Make sure the DPU slot and the DPU are compatible

- Install the DPU in a different PCI Express slot
- Use the drivers that came with the DPU or download the latest
- Make sure your motherboard has the latest BIOS
- Perform a graceful shutdown then power cycle the server

## **DPU no longer works**

- Reseat the DPU in its slot or a different slot, if necessary
- Try using another cable
- Reinstall the drivers for the network driver files may be damaged or deleted
- Perform a graceful shutdown then power cycle the server

## **DPU stopped working after installing another BFB**

- Try removing and reinstalling all DPUs
- Check that cables are connected properly
- Make sure your motherboard has the latest BIOS

## **Link indicator light is off**

- Try another port on the switch
- Make sure the cable is securely attached
- Check you are using the proper cables that do not exceed the recommended lengths
- Verify that your switch and DPU port are compatible

## **Link light is on but no communication is established**

- Check that the latest driver is loaded

- Check that both the DPU and its link are set to the same speed and duplex settings

## Installation Troubleshooting and How-Tos

### BlueField target is stuck inside UEFI menu

Upgrade to the latest stable boot partition images, see "[How to upgrade the boot partition \(ATF & UEFI\) without re-installation](#)".

### BFB does not recognize the BlueField board type

If the .bfb file cannot recognize the BlueField board type, it reverts to low core operation. The following message will be printed on your screen:

```
***System type can't be determined***
***Booting as a minimal system***
```

Please contact NVIDIA Support if this occurs.

### Unable to load BL2, BL2R, or PSC image

The following errors appear in console if images are corrupted or not signed properly:

Device	Error
BlueField	ERROR: Failed to load BL2 firmware
BlueField-2	ERROR: Failed to load BL2R firmware
BlueField-3	Failed to load PSC-BL1 or PSC VERIFY_BCT timeout

### CentOS fails into "dracut" mode during installation

This is most likely configuration related.

- If installing through the RShim interface, check whether /var/pxe/centos7 is mounted or not. If not, either manually mount it or re-run the setup.sh script.
- Check the Linux boot message to see whether eMMC is found or not. If not, the BlueField driver patch is missing. For local installation via RShim, run the setup.sh script with the absolute path and check if there are any errors. For a corporate PXE server, make sure the BlueField and ConnectX driver disk are patched into the initrd image.

## How to find the software versions of the running system

Run the following:

```
/opt/mellanox/scripts/bfvcheck:  
root@bluefield:/usr/bin/bfvcheck# ./bfvcheck  
Beginning version check...  
-RECOMMENDED VERSIONS-  
ATF: v1.5(release):BL2.0-1-gf9f7cdd  
UEFI: 2.0-6004a6b  
FW: 18.25.1010  
-INSTALLED VERSIONS-  
ATF: v1.5(release):BL2.0-1-gf9f7cdd  
UEFI: 2.0-6004a6b  
FW: 18.25.1010  
Version checked
```

Also, the version information is printed to the console.

For ATF, a version string is printed as the system boots.

```
"NOTICE: BL2: v1.3(release):v1.3-554-ga622cde"
```

For UEFI, a version string is printed as the system boots.

```
"UEFI firmware (version 0.99-18d57e3 built at 00:55:30 on Apr 13 2018)"
```

For Yocto, run:

```
$ cat /etc/bluefield_version  
2.0.0.10817
```

## How to upgrade the host RShim driver

See the readme at <BF\_INST\_DIR>/src/drivers/rshim/README.

## How to upgrade the boot partition (ATF & UEFI) without re-installation

1. Boot the target through the RShim interface from a host machine:

```
$ cat <BF_INST_DIR>/sample/install.bfb > /dev/rshim<N>/boot
```

2. Log into the BlueField target:

```
$ /opt/mlnx/scripts/bfrec
```

## How to upgrade ConnectX firmware from Arm side

The mst, mlxburn, and flint tools can be used to update firmware.

For Ubuntu, CentOS and Debian, run the following command from the Arm side:

```
sudo /opt/mellanox/mlnx-fw-updater/mlnx_fw_updater.pl
```

## How to configure ConnectX firmware

Configuring ConnectX firmware can be done using the mlxconfig tool.

It is possible to configure privileges of both the internal (Arm) and the external host (for DPUs) from a privileged host. According to the configured privilege, a host may or may

not perform certain operations related to the NIC (e.g. determine if a certain host is allowed to read port counters).

For more information and examples please refer to the MFT User Manual which can be found at the [following link](#).

## How to use the UEFI boot menu

Press the "Esc" key when prompted after booting (before the countdown timer runs out) to enter the UEFI boot menu and use the arrows to select the menu option.

It could take 1-2 minutes to enter the Boot Manager depending on how many devices are installed or whether the EXPROM is programmed or not.

Once in the boot manager:

- "EFI Network xxx" entries with device path "PciRoot..." are ConnectX interface
- "EFI Network xxx" entries with device path "MAC(..." are for the RShim interface and the BlueField OOB Ethernet interface

Select the interface and press ENTER will start PXE boot.

The following are several useful commands under UEFI shell:

```
Shell> ls FS0: # display file
Shell> ls FS0:\EFI # display file
Shell> cls # clear screen
Shell> ifconfig -l # show interfaces
Shell> ifconfig -s eth0 dhcp # request DHCP
Shell> ifconfig -l eth0 # show one interface
Shell> tftp 192.168.100.1 grub.cfg FS0:\grub.cfg # tftp download a file
Shell> bcfg boot dump # dump boot variables
Shell> bcfg boot add 0 FS0:\EFI\centos\shim.efi "CentOS" # create an entry
```

## How to Use the Kernel Debugger (KGDB)

The default Yocto kernel has CONFIG\_KGDB and CONFIG\_KGDB\_SERIAL\_CONSOLE enabled. This allows the Linux kernel on BlueField to be debugged over the serial port. A single serial

port cannot be used both as a console and by KGDB at the same time. It is recommended to use the RShim for console access (`/dev/rshim0/console`) and the UART port (`/dev/ttyAMA0` or `/dev/ttyAMA1`) for KGDB. Kernel GDB over console (KGDBOC) does not work over the RShim console. If the RShim console is not available, there are open-source packages such as KGDB demux and agent-proxy which allow a single serial port to be shared.

There are two ways to configure KGDBOC. If the OS is already booted, then write the name of the serial device to the KGDBOC module parameter. For example:

```
$ echo ttyAMA1 > /sys/module/kgdboc/parameters/kgdboc
```

To attach GDB to the kernel, it must be stopped first. One way to do that is to send a "g" to `/proc/sysrq-trigger`.

```
$ echo g > /proc/sysrq-trigger
```

To debug incidents that occur at boot time, kernel boot parameters must be configured. Add "`kgdboc=ttyAMA1,115200 kgdwait`" to the boot arguments to use UART1 for debugging and force it to wait for GDB to attach before booting.

Once the KGDBOC module is configured and the kernel stopped, run the Arm64 GDB on the host machine connected to the serial port, then set the remote target to the serial device on the host side.

```
<BF_INST_DIR>/sdk/sysroots/x86_64-pokysdk-linux/usr/bin/aarch64-poky-
linux/aarch64-poky-linux-gdb <BF_INST_DIR>/sample/vmlinux

(gdb) target remote /dev/ttyUSB3
Remote debugging using /dev/ttyUSB3
arch_kgdb_breakpoint () at
/labhome/dwoods/src/bf/linux/arch/arm64/include/asm/kgdb.h:32
32 asm ("brk %0" : : "I" (KGDB_COMPILED_DBG_BRK_IMM));
(gdb)
```

`<BF_INST_DIR>` is the directory where the BlueField software is installed. It is assumed that the SDK has been unpacked in the same directory.

## How to enable/disable SMMU

SMMU could affect performance for certain applications. It is disabled by default and can be modified in different ways.

- Enable/disable SMMU in the UEFI System Configuration
- Set it in bf.cfg and push it together with the install.bfb (see section "[Installing Popular Linux Distributions on BlueField](#)")
- In BlueField Linux, create a file with one line with SYS\_ENABLE\_SMMU=TRUE, then run bfcfg.

The configuration change will take effect after reboot. The configuration value is stored in a persistent UEFI variable. It is not modified by OS installation.

See section "[UEFI System Configuration](#)" for information on how to access the UEFI System Configuration menu.

## How to change the default console of the install image

On UART0:

```
$ echo "console=ttyAMA0 earlycon=pl011,0x01000000 initrd=initramfs" > bootarg  
$ <BF_INST_DIR>/bin/mlx-mkbf --boot-args bootarg \  
<BF_INST_DIR>/sample/install.bfb
```

On UART1:

```
$ echo "console=ttyAMA1 earlycon=pl011,0x01000000 initrd=initramfs" > bootarg  
$ <BF_INST_DIR>/bin/mlx-mkbf --boot-args bootarg \  
<BF_INST_DIR>/sample/install.bfb
```

On RShim:

```
$ echo "console=hvc0 initrd=initramfs" > bootarg  
$ <BF_INST_DIR>/bin/mlx-mkbf --boot-args bootarg \  
 
```

```
<BF_INST_DIR>/sample/install.bfb
```

## How to change the default network configuration during BFB installation

On Ubuntu OS, the default network configuration for tmfifo\_net0 and oob\_net0 interfaces is set by the cloud-init service upon first boot after BFB installation.

The default content of /var/lib/cloud/seed/nocloud-net/network-config as follows:

```
# cat /var/lib/cloud/seed/nocloud-net/network-config
version: 2
renderer: NetworkManager
ethernets:
  tmfifo_net0:
    dhcp4: false
    addresses:
      - 192.168.100.2/30
    nameservers:
      addresses: [ 192.168.100.1 ]
    routes:
      - to: 0.0.0.0/0
        via: 192.168.100.1
        metric: 1025
  oob_net0:
    dhcp4: true
```

This content can be modified during BFB installation using bf.cfg. For example:

```
# cat bf.cfg
bfb_modify_os()
{
  sed -i -e '/oob_net0/,+1d' /mnt/var/lib/cloud/seed/nocloud-net/network-config
  cat >> /mnt/var/lib/cloud/seed/nocloud-net/network-config << EOF
  oob_net0:
```

```
    dhcp4: false
    addresses:
      - 10.0.0.1/24
EOF
}

# bfb-install -c bf.cfg -r rshim0 -b <BFB>
```

 **Note**

Using the same technique, any configuration file on the BlueField DPU side can be updated during the BFB installation process.

## Sanitizing DPU eMMC and SSD Storage

During the BFB installation process, DPU storage can be securely sanitized either using the shred or the mmc and nvme utilities in the bf.cfg configuration file as illustrated in the following subsections.

 **Note**

By default, only the installation target storage is formatted using the Linux mkfs utility.

## Using shred Utility

```
# cat bf.cfg
SANITIZE_DONE=${SANITIZE_DONE:-0}
export SANITIZE_DONE
if [ $SANITIZE_DONE -eq 0 ]; then
```

```

sleep 3m
/sbin/modprobe nvme

if [ -e /dev/mmcblk0 ]; then
echo Sanitizing /dev/mmcblk0 | tee /dev/kmsg
echo Sanitizing /dev/mmcblk0 > /tmp/sanitize.emmc.log
mmc sanitize /dev/mmcblk0 >> /tmp/sanitize.emmc.log 2>&1
fi

if [ -e /dev/nvme0n1 ]; then
echo Sanitizing /dev/nvme0n1 | tee /dev/kmsg
echo Sanitizing /dev/nvme0n1 > /tmp/sanitize.ssd.log
nvme sanitize /dev/nvme0n1 -a 2 >> /tmp/sanitize.ssd.log 2>&1
nvme sanitize-log /dev/nvme0n1 >> /tmp/sanitize.ssd.log 2>&1
fi

SANITIZE_DONE=1
echo ===== sanitize.log ===== | tee
/dev/kmsg
cat /tmp/sanitize.*.log | tee /dev/kmsg
sync
fi

fbf_modify_os()
{
echo ===== bfb_modify_os ===== | tee
/dev/kmsg
if ( /bin/ls -1 /tmp/sanitize.*.log > /dev/null 2>&1 ); then
cat /tmp/sanitize.*.log > /mnt/root/sanitize.log
fi
}

```

## Using mmc and nvme Utilities

```

# cat bf.cfg
SANITIZE_DONE=${SANITIZE_DONE:-0}
export SANITIZE_DONE

```

```

if [ $SANITIZE_DONE -eq 0 ]; then
    sleep 3m
    /sbin/modprobe nvme

    if [ -e /dev/mmcblk0 ]; then
        echo Sanitizing /dev/mmcblk0 | tee /dev/kmsg
        echo Sanitizing /dev/mmcblk0 > /tmp/sanitize.emmc.log
        mmc sanitize /dev/mmcblk0 >> /tmp/sanitize.emmc.log 2>&1
    fi

    if [ -e /dev/nvme0n1 ]; then
        echo Sanitizing /dev/nvme0n1 | tee /dev/kmsg
        echo Sanitizing /dev/nvme0n1 > /tmp/sanitize.ssd.log
        nvme sanitize /dev/nvme0n1 -a 2 >> /tmp/sanitize.ssd.log 2>&1
        nvme sanitize-log /dev/nvme0n1 >> /tmp/sanitize.ssd.log 2>&1
    fi

    SANITIZE_DONE=1
    echo ===== sanitize.log ===== | tee
    /dev/kmsg
    cat /tmp/sanitize.*.log | tee /dev/kmsg
    sync
fi

bfb_modify_os()
{
    echo ===== bfb_modify_os ===== | tee
    /dev/kmsg
    if ( /bin/ls -1 /tmp/sanitize.*.log > /dev/null 2>&1 ); then
        cat /tmp/sanitize.*.log > /mnt/root/sanitize.log
    fi
}

```

# Windows Support

## Network Drivers

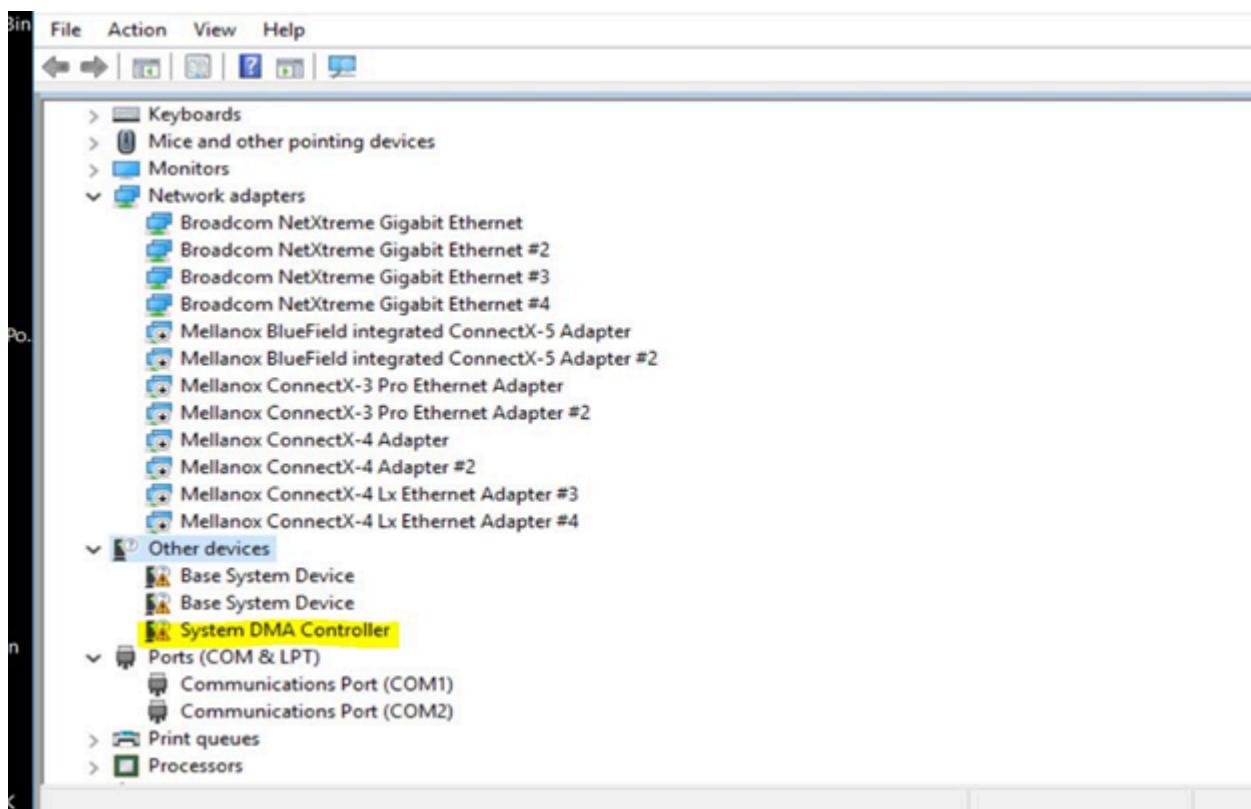
BlueField Windows support from the host-side is facilitated by the WinOF-2 driver. For more information on WinOF-2 (including installation), please refer to the [WinOF-2 Documentation](#).

## RShim Drivers

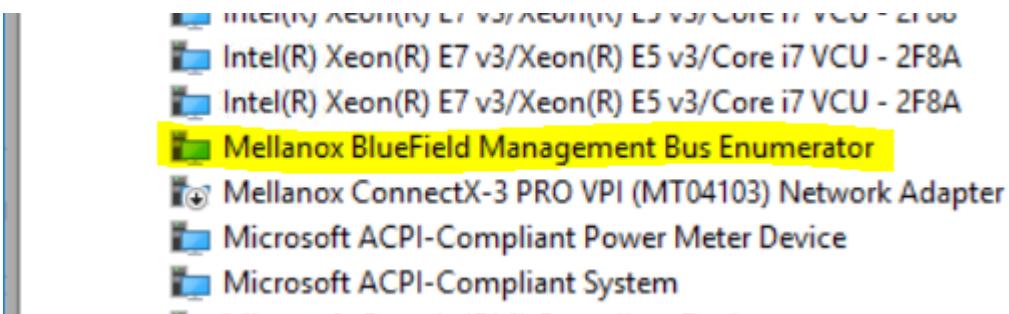
RShim drivers provide functionalities like resetting the Arm cores, pushing a bootstream image, as well as some networking and console functionalities.

## Verifying RShim Drivers Installation

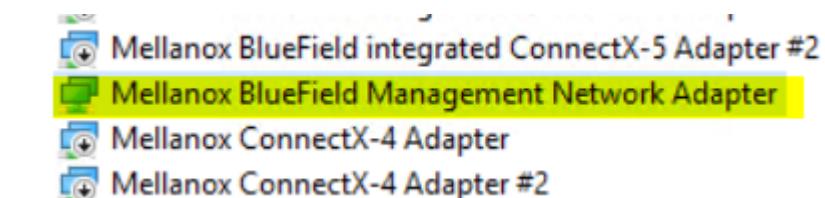
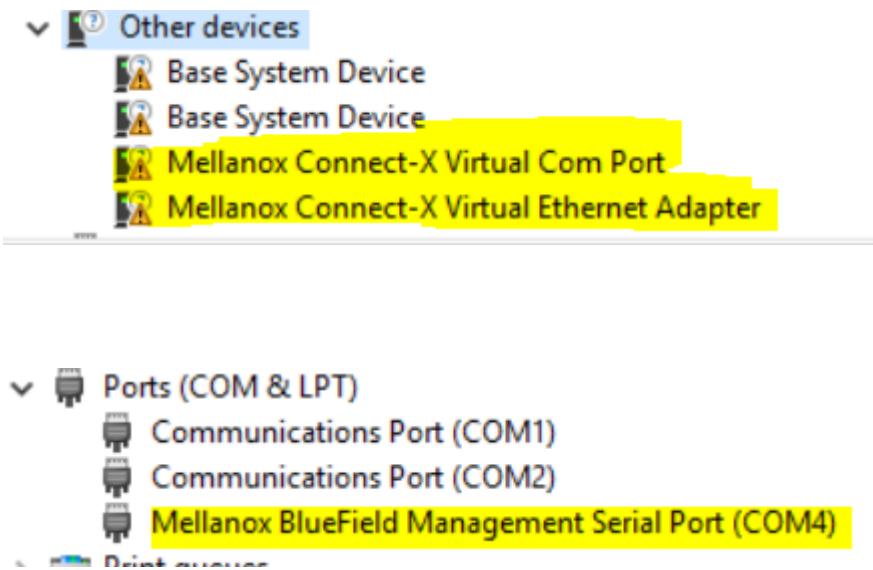
1. Open the Device Manager when no drivers are installed to make sure a new PCIe device is available as below.



2. Run the installer to install all 3 drivers (MlxRshimBus.sys, MlxRshimCom.sys, and MlxRshimEth.sys).



3. Make sure the Bus driver created 2 child devices after the installation (Com port and the Ethernet adapter).



At this time, PuTTY application or any other network utility can be used to communicate with DPU via Virtual Com Port or Virtual Ethernet Adapter (ssh). The Com Port can be used using the 9600 baud-rate and default settings.

**Note**

RShim drivers can be connect via PCIe (the drivers we are providing) or via USB (external connection) but not both at the same time. So when the bus driver detects that an external USB is already attached, it will not create the child virtual devices for data access. Access via PCIe is available once the USB connection is removed.

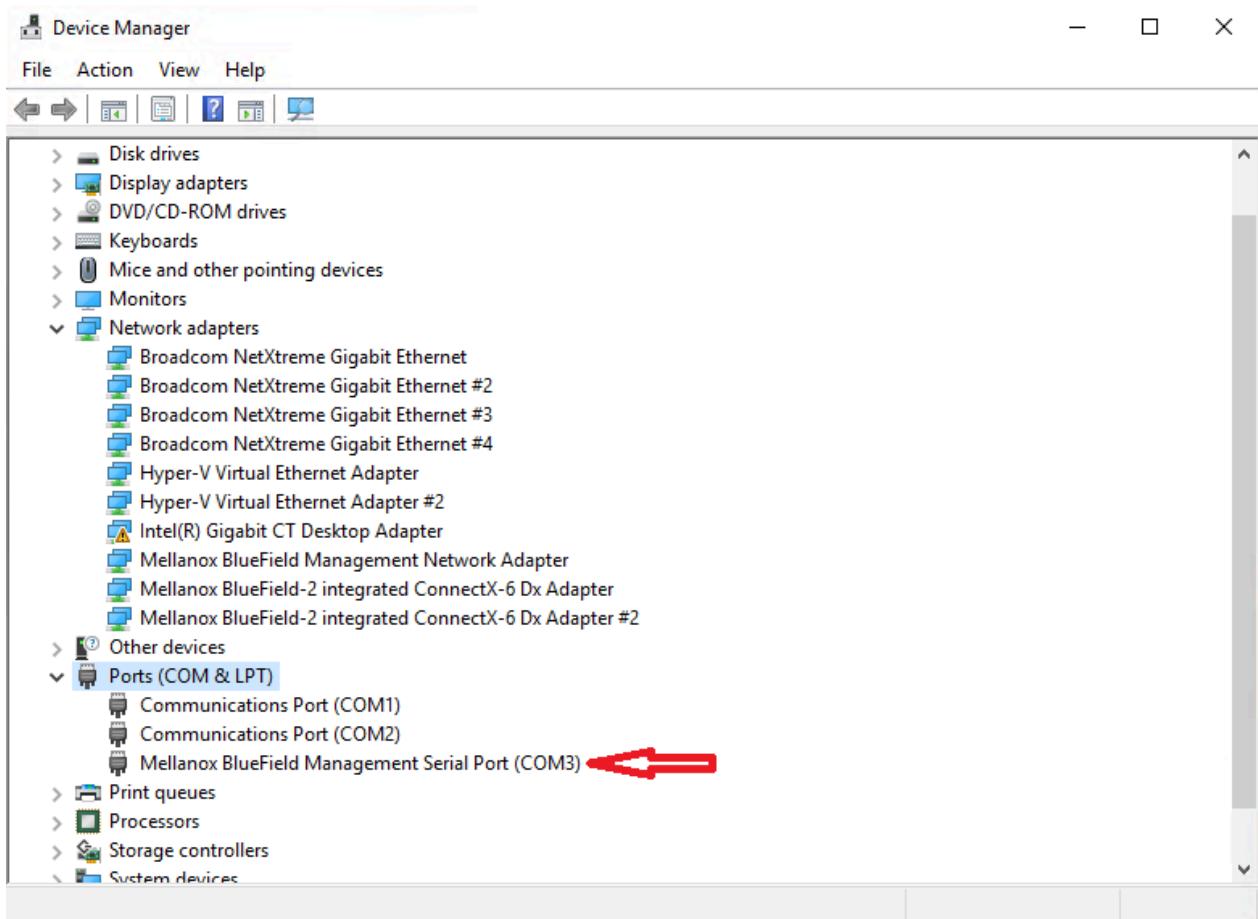
## Accessing BlueField DPU From Host

The BlueField DPU can be accessed via PuTTY or any other network utility application to communicate via virtual COM or virtual Ethernet adapter. To use COM:

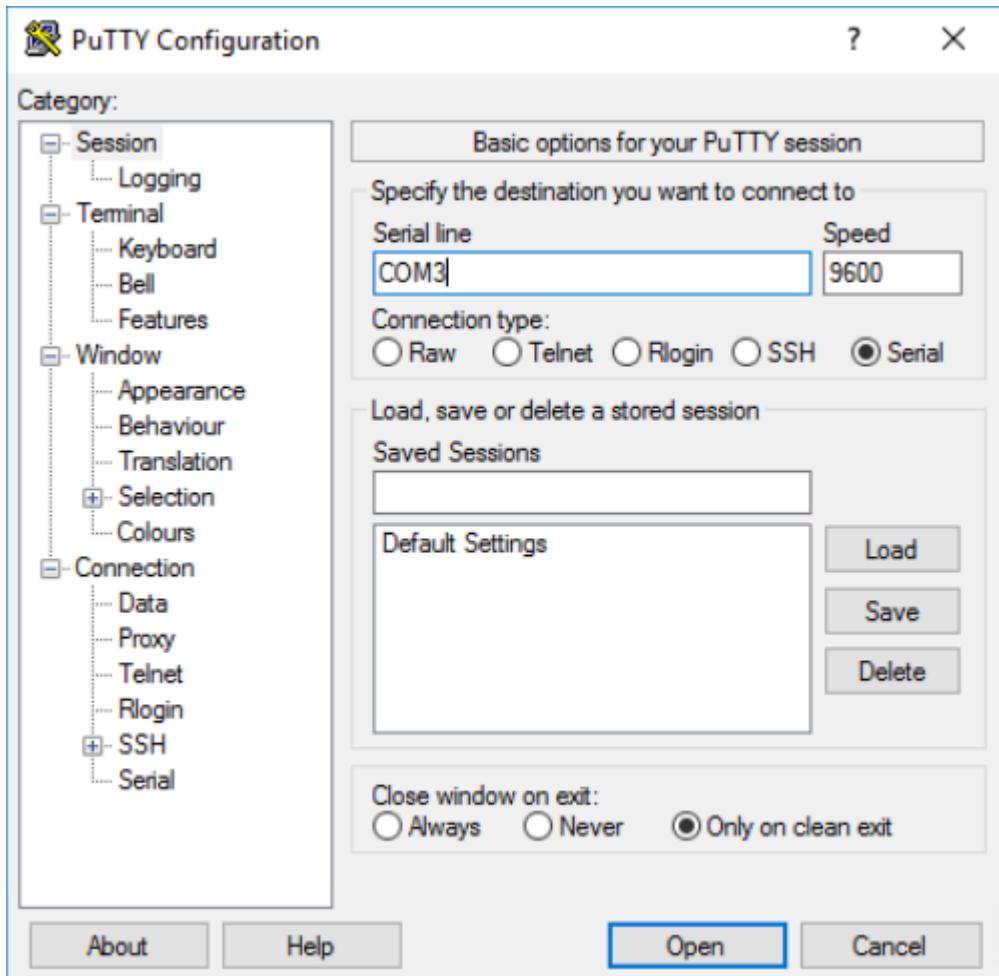
1. Open Putty.
2. Change connection type to Serial.
3. Run the following command in order to know what to set the "Serial line" field to:

```
C:\Users\username\Desktop> reg query  
HKLM\HARDWARE\DEVICEMAP\SERIALCOMM | findstr MIxRshim  
\MIxRshim\COM3 REG-SZ COM3
```

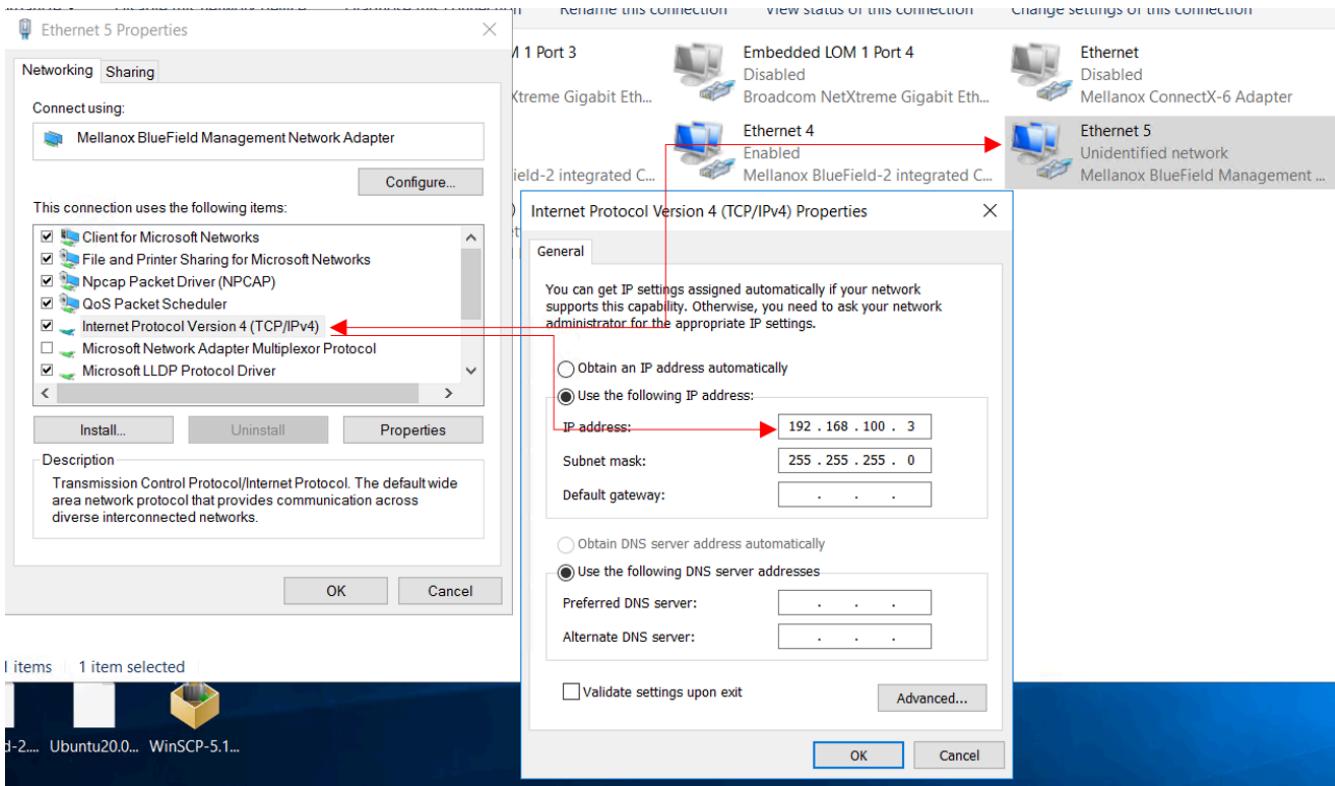
In this case use COM3. This name can also be found via Device Manager under "Ports (Com & LPT)".



4. Press Open and hit Enter.



To access via BlueField management network adapter, configure an IP address as shown in the example below and run a ping test to confirm configuration.



## RShim Ethernet Driver

The device does not support any type of stateful or stateless offloads. This is indicated to the Operating System accordingly when the driver loads. The MAC address is a pre-defined MAC address (CA-FE-01-CA-FE-02). The following registry keys can be used to change basic settings such as MAC address.

Registry Name	Description	Valid Values
HKLM\SYSTEM\CurrentControlSet\Control\Class\{4d36e972-e325-11ce-bfc1-08002be10318}\<nn>\*JumboPacket	The size, in bytes, of the largest supported Jumbo Packet (an Ethernet frame that is greater than 1514 bytes) that the hardware can support.	1514 (default) - 2048
HKLM\SYSTEM\CurrentControlSet\Control\Class\{4d36e972-e325-11ce-bfc1-08002be10318}\<nn>\*NetworkAddress	The network address of the device. The format for a MAC address is: XX-XX-XX-XX-XX-XX.	CA-FE-01-CA-FE-02 (default)
HKLM\SYSTEM\CurrentControlSet\Control\Class\{4d36e972-e325-	The number of receive descriptors used by the miniport adapter.	16 – 64 (Default)

Registry Name	Description	Valid Values
11ce-bfc1-08002be10318}\<nn>\ReceiveBuffers		

 **Note**

Update the MAC address manually using registry key if there are more than one BlueField DPU in the system.

For instructions on how to find interface index in the registry (nn), please refer to section "Finding the Index Value of the Network Interface" in the [WinOF-2 User Manual](#) under Features Overview and Configuration > Configuring the Driver Registry Keys.

## MlxRshimBus Driver

This driver does all the read/write work to the hardware registers. User space application can send down IOCTL's to restart the system on chip or to push a new BlueField boot stream image.

## RshimCmd Tool

RshimCmd is a command line tool that enables the user to:

- Restart the DPU.
- Push a boot stream file (.bfb). A BFB file is a generated BlueField boot stream file that contains Linux operating system image that runs on the DPU. BFB files can be downloaded from the [NVIDIA DOCA SDK](#) webpage.

Usage	RshimCmd -RestartSmartNic <Option> -BusNum <BusNum>
Example	<pre>RshimCmd -EnumDevices RshimCmd -PushImage c:\bin\MLnxBootImage.bfb -BusNum 11</pre>

	RshimCmd -RestartSmartNic 1 -BusNum 11
Detailed Usage	RshimCmd -h

### Note

The BFB image can be either CentOS or Ubuntu. Ubuntu credentials are: ubuntu/ubuntu and for Centos credentials are: root/centos, IP address of RShim Ethernet component (called tmfifo\_net0) on the BlueField side is 192.168.100.2/30 by default. Please set IP address on the Windows side accordingly to be able to communicate via SSH.

## BlueField UEFI System Boot Customizations during Installation

Bluefield's UEFI system boot options and more can be customized during the BFB Installation through the use of configuration parameters in the bf.cfg file. For further information on the bf.cfg file, refer to the [BlueField Documentation](#).

To include the bf.cfg file into the BFB installation, append the file to BFB file as described below:

1. Copy the BFB file to a local folder. For example:

```
Copy <path>\DOCA_1.4.0_BSP_3.9.2_Ubuntu_20.04-5.20220707.bfb
c:\bf\MLnxBootImage.bfb
```

2. Append the bf.cfg file into the BFB file.

```
Cd c:\bf
Copy /b MLnxBootImage.bfb + bf.cfg MLnxBootImage_with_bf_cfg.bfb
```

3. Download the BFB image.

```
RshimCmd -PushImage c:\bf\MIinxBootImage_with_bf_cfg.bfb -BusNum 11
```

As the bf.cfg is intended for Linux OSes, it should be created according to Linux rules. For example, the lines of this text file should end in LF and not in CR/LF as accepted in Windows.

All the syntax should be as the accepted by the OS expects. For example, there should be no spaces in the middle of "set" statements: NET\_RSHIM\_MAC=00:1a:ca:ff:ff:05.

## EventLogs and Driver Logging

All driver logging is part of the Mellanox-WinOF2-Kernel trace session that comes with the network drivers installation. The default location to the trace is at %SystemRoot%\system32\LogFiles\MIinx\Mellanox-WinOF2-System.etl.

The following are the Event logs RShim drivers generate:

## MIxRShimBus Driver

Event ID	Severity	Message
2	Informational	RShim Bus driver loaded successfully
3	Informational	Device successfully stopped
4	Error	The SmartNIC seems to be stuck as the boot FIFO data is not being drained.
5	Error	Driver startup failed due to failure in creation of the child device.
6	Error	SmartNIC is in a bad state. Please restart SmartNIC and reload bus drivers. Please refer to user manual on how to restart SmartNIC.
7	Warning	SmartNIC is in LiveFish mode
8	Warning	Failed creating child virtual devices as a backend USB device is attached

Event ID	Severity	Message
	g	and accessing RShim FIFO. Please refer to user manual for more details.

## MlxRShim Serial Driver

Event ID	Severity	Message
2	Informational	RShim serial driver loaded successfully
3	Informational	device successfully stopped

## MlxRShim Ethernet Driver

Event ID	Severity	Message
2	Error	MAC address read from registry is not supported. Please set valid unicast address.
3	Informational	Device is successfully stopped
4	Warning	Value read from registry is invalid. Therefore use the default value.
5	Error	SmartNIC seems stuck as transmit packets are not being drained.
6	Informational	RShim Ethernet driver loaded successfully

---

# Document Revision History

## Rev 4.7.0 – May 06, 2024

Added:

- Section "[UEFI Menu](#)"
- Section "[Redfish](#)"
- Section "[BlueField SR-IOV](#)"
- Section "[NVIDIA BlueField Reset and Reboot Procedures](#)" and updated graceful shutdown guidance with pointers to this section

Updated:

- Section "[Software Installation and Upgrade](#)" with bf-fwbundle-<version>.prod.bfb information
- Section "[BFB Installation](#)"
- Section "[Changing Default Credentials Using bf.cfg](#)"
- Section "[Configuring NIC Mode on BlueField-3 Using Redfish](#)"

## Rev 4.6.0 – February 08, 2024

Added:

- Page "[Default Passwords and Policies](#)"
- Section "[VF Msix\\_num/Queue Requirement](#)"

Updated:

- Section "[Customization of BFB Installation Using bf.cfg](#)"

- Section "[bf.cfg Parameters](#)"
- Section "[Configuring NIC Mode on BlueField-3 Using Redfish](#)"
- Section "[Configuring NIC Mode on BlueField-3 from UEFI](#)"
- Section "[NIC Mode for BlueField-2](#)"
- Section "[Default Ports and OVS Configuration](#)"
- Section "[SystemD Service](#)"

## **Rev 4.5.0 – December 12, 2023**

Added:

- Section "[Updating Software Using Redfish](#)"
- Section "[Sanitizing DPU eMMC and SSD Storage](#)"
- Section "[How to perform graceful shutdown](#)"
- Section "[BFB installation monitoring](#)"

Updated:

- Page "[Updating DPU Software Packages Using Standard Linux Tools](#)"
- Section "[RShim Logging](#)"
- Section "[NIC Mode](#)"
- Section "[Enabling OVS-DPDK Hardware Offload](#)"
- Section "[Enabling IPsec Packet Offload](#)"
- Section "[Setting IPsec Packet Offload Using strongSwan](#)"
- Section "[Running strongSwan Example](#)"
- Section "[Building strongSwan](#)"

- Section "[IPsec Packet Offload and OVS Offload](#)"

## Rev 4.2.2 – October 24, 2023

Updated:

- Section "[NIC Mode](#)"

## Rev 4.2.0 – August 10, 2023

Updated:

- Step 3 under section "[PXE Server Preparations](#)"
- Section "[Removing Previously Installed DOCA Runtime Packages](#)"
- Section "[NIC Mode](#)"
- Sections "[Connection Tracking With NAT](#)" and "[Querying Connection Tracking Offload Status](#)" with conntack command for Ubuntu 22.04 kernels
- Section "[LAG Configuration](#)"
- Section "[SystemD Service](#)"
- Page "[QoS Configuration](#)"
- Section "[bf.cfg Parameters](#)"

## Rev 4.0.2 – May 08, 2023

Added:

- Page "[SoC Management Interface](#)"
- Page "[Legal Notices and 3rd Party Licenses](#)"
- Section "[Unable to load BL2, BL2R, or PSC image](#)"

Updated:

- Section "[Default Ports and OVS Configuration](#)" with new step 2
- Section "[BlueField Linux Drivers](#)" with gpio-mlxbf3, mlxbf-ptm, pwr-mlxbf, and pinctrl-mlxbf
- Page "[Updating DPU Software Packages Using Standard Linux Tools](#)"
- Page "[UEFI Secure Boot](#)"
- Section "[IPsec Hardware Offload: Full Offload](#)" with Canonical note
- Section "[How to upgrade ConnectX firmware from Arm side](#)"
- Section "[VirtIO-net PF Device Configuration](#)" by removing ECPF\_ESWITCH\_MANAGER and ECPF\_PAGE\_SUPPLIER from step 4
- Section "[Virtio-net SR-IOV VF Device Configuration](#)" by removing ECPF\_ESWITCH\_MANAGER and ECPF\_PAGE\_SUPPLIER from step 7.b
- Section "[vDPA over VirtIO Full Emulation](#)"

## **Rev 3.9.3 – November 02, 2022**

Added:

- Section "[DHCP Client Configuration](#)"
- Section "[Updating DPU Software Packages Using Standard Linux Tools](#)"
- Section "[Creating Transitional Hotplug VirtIO-net PF Device](#)"
- Section "[Transitional VirtIO-net VF Device Support](#)"

Updated:

- Section "[Upgrading Boot Software](#)" by specifying that the "Reset EFI Variables" action also wipes the BOOT option variables and secure boot keys
- Section "[BlueField Linux Drivers](#)"
- Section "[Configuring Uplink MTU](#)"

- Section "[Disabling Host Networking PFs](#)" by adding instructions for reactivating host networking for single-port DPUs
- Section "[Configuring RegEx Acceleration on BlueField-2](#)"
- Section "[Virtio-net SR-IOV VF Device Configuration](#)"
- PXE\_DHCP\_CLASS\_ID in section "[bf.cfg Parameters](#)"

Removed:

- Step 7 in section "[Configuring Host Server Side](#)"
- Separated Mode from "[Modes of Operation](#)"

## Rev 3.9.2 – August 02, 2022

Added:

- Section "[Updating NVConfig Params](#)"
- Page "[System Configuration and Services](#)"
- Section "[Enrolling New NVIDIA Certificates](#)"
- Section "[bf.cfg Parameters](#)"
- Support for OpenSSL version 3.0.2 in section "[PKA Use Cases](#)"
- Section "[How to change the default network configuration during BFB installation](#)"

Updated:

- Section "[Firmware Upgrade](#)"
- Section "[Customizations During BFB Installation](#)"
- Section "[UEFI System Configuration](#)"
- Page "[Host-side Interface Configuration](#)"
- Section "[Enrolling Certificates Using Capsule](#)"

- Section "[NIC Mode](#)" with supported MLNX\_OFED versions
- Section "[PKA Use Cases](#)" with support for OpenSSL version 3.0.2

## Rev 3.9 – May 03, 2022

Added:

- Section "[GRUB Password Protection](#)"
- New note under step 2 in section "[Default Ports and OVS Configuration](#)"
- Section "[BlueField Linux Drivers](#)"
- Canonical db certificate to section "[Existing DPU Certificates](#)"
- New note under section "[Enrolling Certificates Using Capsule](#)"
- New power cycle note under section "[Enabling Host Restriction](#)"
- New power cycle note under section "[Disabling Host Restriction](#)"
- Section "[NIC Mode](#)"
- Section "[LAG on Multi-host](#)"
- New power cycle note under section "[Disabling Host Networking PFs](#)"
- Section "[PKA Prerequisites](#)"
- Section "[OVS IPsec](#)"
- Section "[Rate Limiting VF Group](#)"
- Note to section "[User Frontend](#)"
- Section "[Controller Live Update](#)"

Updated:

- Code block in section "[Customizations During BFB Installation](#)"

- Section "[Building Your Own BFB Installation Image](#)"
- Section "[Configuring VXLAN Tunnel](#)"
- Step 2 in section "[Prerequisites](#)"
- Section "[Enabling IPsec Full Offload](#)"
- Code block under step 1 in section "[LAG Configuration](#)"

## **Rev 3.8.5 - January 19, 2022**

Added:

- Section "[Another backend already attached](#)"

Updated:

- Section "[Ensure RShim Running on Host](#)"

---

# Legal Notices and 3rd Party Licenses

BlueField Software Components	Version	3rd Party Components and Licenses
DOCA SDK	2.7.0	<a href="#">Link</a>
DOCA SDK 3 <sup>rd</sup> Party Notice		<a href="#">Link</a>
DOCA SDK 3 <sup>rd</sup> Party Unify Notice		<a href="#">Link</a>
SoC OS Linux Ubuntu 22.04 Distro	5.15.0-1042-bluefield	<a href="#">Link</a>
SoC OS Linux Ubuntu 20.04 Distro	5.4.0-1084-bluefield	<a href="#">Link</a>
BSP – ATF	4.7.0	<a href="#">Link</a>
BSP – ATF 3 <sup>rd</sup> Party Notice		<a href="#">Link</a>
BSP – ATF 3 <sup>rd</sup> Party Unify Notice		<a href="#">Link</a>
BSP – UEFI (EDK2)	4.7.0	<a href="#">Link</a>
BlueField UEFI (EDK2) 3 <sup>rd</sup> Party Notice		<a href="#">Link</a>
BlueField UEFI (EDK2) 3 <sup>rd</sup> Party Unify Notice		<a href="#">Link</a>
BlueField BMC	24.04	<a href="#">Link</a>
BlueField BMC 3 <sup>rd</sup> Party Notice		<a href="#">Link</a>
BlueField BMC 3 <sup>rd</sup> Party Unify Notice		<a href="#">Link</a>
Virtio Network Controller	1.9.12	<a href="#">Link</a>
Virtio Network Controller 3 <sup>rd</sup> Party Notice		<a href="#">Link</a>

BlueField Software Components	Version	3 <sup>rd</sup> Party Components and Licenses
Virtio Network Controller 3 <sup>rd</sup> Party Unify Notice		<a href="#">Link</a>
MLNX LibSnap and virtio-blk		<a href="#">Link</a>
MLNX LibSnap and virtio-blk 3 <sup>rd</sup> Party Notice	1.6.0-1	<a href="#">Link</a>
MLNX SNAP and SPDK		<a href="#">Link</a>
MLNX SNAP and SPDK 3 <sup>rd</sup> Party Notice	3.8.0-1	<a href="#">Link</a>
NVIDIA MLNX_OFED License		<a href="#">Link</a>
NVIDIA MLNX_OFED 3 <sup>rd</sup> Party Unify Notice	24.04-0	<a href="#">Link</a>
NVIDIA MFT License		<a href="#">Link</a>
NVIDIA MFT 3 <sup>rd</sup> Party Notice	4.28.0	<a href="#">Link</a>
NVIDIA MLNX_DPDK		<a href="#">Link</a>
NVIDIA MLNX_DPDK 3 <sup>rd</sup> Party Notice	22.11.2404.1.0	<a href="#">Link</a>
NVIDIA MLNX_DPDK 3 <sup>rd</sup> Party Unify Notice		<a href="#">Link</a>

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