



Mellanox ConnectX[®]-5 VPI Dual Port Socket Direct Adapter Card User Manual for Dual-Socket Servers

P/N:
MCX556M-ECAT-S25

Rev 1.6



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Revision History

This document was printed on March 8, 2018.

Table 1 - Revision History Table

Date	Rev	Comments/Changes
March 2018	1.6	<ul style="list-style-type: none"> Added Package Contents on page 11 Updated the Introduction on page 9 Added a note to Card Installation Instructions on page 18 Updated Downloading Mellanox OFED on page 26 Updated examples in Installation Procedure on page 29 Updated snapshots in Windows Driver on page 44
January 2018	1.5	<ul style="list-style-type: none"> Added a note to System Requirements on page 16 Updated MCX556M-ECAT-S25 Specifications on page 61 Added a note to Board Mechanical Drawing and Dimensions on page 63 Updated Adapter Card LED Operations on page 62
June 2017	1.4	<ul style="list-style-type: none"> Updated Product Overview on page 10 Added Bracket Installation Instructions on page 17
May 2017	1.3	<ul style="list-style-type: none"> Updated Interface Connectors Pinout on page 65
May 2017	1.2	<ul style="list-style-type: none"> Updated Product Overview on page 10 Updated Hardware on page 17 Updated Cable Installation on page 21
April 2017	1.1	<ul style="list-style-type: none"> Updated Linux on page 26. Updated Windows Driver on page 44
March 2017	1.0	First release

About This Manual

This User Manual describes Mellanox Technologies ConnectX®-5 VPI adapter card supporting Dual-Socket Servers. The kit includes an adapter card with dual QSFP28 ports with PCI Express x8 edge connector, an auxiliary PCIe connection card with PCI Express x8 edge connector and a Slim-Line SAS cable which connects both cards. The User Manual provides details as to the interfaces of the adapter card, specifications, required software and firmware for operating the adapter card, and relevant documentation

Intended Audience

This manual is intended for the installer and user of these cards.

The manual assumes basic familiarity with InfiniBand and Ethernet network and architecture specifications.

Related Documentation

Table 2 - Documents List

<p><i>Mellanox Firmware Tools (MFT) User Manual</i> Document no. 2204UG</p>	<p>User Manual describing the set of MFT firmware management tools for a single node. See http://www.mellanox.com => Products => Software => Firmware Tools</p>
<p><i>Mellanox Firmware Utility (mlxup) User Manual and Release Notes</i></p>	<p>Mellanox firmware update and query utility used to update the firmware. See http://www.mellanox.com => Products => Software => Firmware Tools => mlxup Firmware Utility</p>
<p><i>Mellanox OFED for Linux User Manual</i> Document no. 2877</p>	<p>User Manual describing OFED features, performance, Band diagnostic, tools content and configuration. See http://www.mellanox.com => Products => Software => InfiniBand/VPI Drivers => Mellanox OpenFabrics Enterprise Distribution for Linux (MLNX_OFED)</p>
<p><i>Mellanox OFED for Linux Release Notes</i> Document no. 2877</p>	<p>Release Notes for Mellanox OFED for Linux driver kit for Mellanox adapter cards: See: http://www.mellanox.com => Products => Software => InfiniBand/VPI Drivers => Linux SW/Drivers => Release Notes</p>
<p><i>WinOF-2 for Windows User Manual</i> Document no. MLX-15-3280</p>	<p>User Manual describing WinOF-2 features, performance, Ethernet diagnostic, tools content and configuration. See http://www.mellanox.com => Products => Software => Windows SW/Drivers</p>
<p><i>Mellanox OFED for Windows Driver Release Notes</i></p>	<p>Release notes for Mellanox Technologies' MLNX_EN for Linux driver kit for Mellanox adapter cards: See http://www.mellanox.com => Products => Software => Ethernet Drivers => Mellanox OFED for Windows => WinOF-2 Release Notes</p>

IBTA Specification Release 1.3

InfiniBand Architecture Specification:
http://www.infinibandta.org/content/pages.php?pg=technology_public_specification

IEEE Std 802.3 Specification

This is the IEEE Ethernet specification
<http://standards.ieee.org/getieee802>

PCI Express 3.0 Specifications

Industry Standard PCI Express 3.0 Base and Card Electromechanical Specifications
<https://pcisig.com/specifications>

Document Conventions

When discussing memory sizes, MB and MBytes are used in this document to mean size in mega Bytes. The use of Mb or Mbits (small b) indicates size in mega bits. IB is used in this document to mean InfiniBand. In this document PCIe is used to mean PCI Express.

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- E-mail: support@mellanox.com
- Tel: +1.408.916.0055

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<http://www.mellanox.com/supportdownloader/>.

1 Introduction

This is the User Guide for Mellanox Technologies VPI adapter cards based on the ConnectX®-5 integrated circuit device. Mellanox offers an alternate ConnectX-5 Socket Direct™ card for servers without x16 PCIe slots. The adapter’s 16-lane PCIe bus is split into two 8-lane buses, with one bus accessible through a PCIe x8 edge connector and the other bus through an x8 parallel connector to an Auxiliary PCIe Connection Card. The two cards should be installed into two adjacent PCIe x8 slots and connected using a dedicated harness.

Figure 1: ConnectX-5 VPI Socket Direct Card



Since the two PCIe cards are installed in two PCIe slots, each card gets a unique PCI Bus and Device number. Each of the PCIe x8 busses sees two network ports; in effect, the two 100Gb/s physical ports of the ConnectX-5 Socket Direct Adapter are viewed as four netdevices by the system, with each netdevice providing a maximum of 50Gb/s data transfer rate. In other words, 100Gb/s on a (physical) adapter port (Port 1 or Port 2) will be split on the PCIe side to 50Gb/s on each of the two PCIe cards (the Adapter Card and the Auxiliary PCIe Connection Cards, respectively, in [Figure 1](#)).

This chapter covers the following topics:

- [Section 1.1, “Product Overview”, on page 10](#)
- [Section 1.3, “Features and Benefits”, on page 12](#)
- [Section 1.4, “Operating Systems/Distributions”, on page 14](#)
- [Section 1.5, “Connectivity”, on page 14](#)
- [Section 1.6, “Manageability”, on page 14](#)

1.1 Product Overview

The following section provides the ordering part number, port speed, number of ports, and PCI Express speed. The adapter card and auxiliary PCIe connection card come with tall and short brackets.

Table 3 - Dual-port VPI Adapter Cards

Ordering Part Number (OPN)	MCX556M-ECAT-S25
Data Transmission Rate	InfiniBand: SDR/DDR/QDR/FDR/EDR Ethernet: 1/10/25/40/50/100 Gb/s
Network Connector Types	Dual-port QSFP28 located on the low profile adapter card
PCI Express (PCIe) SerDes Speed	Dual PCIe 3.0 x8 8GT/s
RoHS	R6
Adapter IC Part Number	MT28808A0-FCCF-EVM
Device ID (decimal)	4119 for Physical Function (PF) 4120 for Virtual Function (VF)



Full performance of the adapter card (100Gb/s) is possible only when installing both the adapter card and the auxiliary PCIe connection card in the dual PCIe x8 connectors. Please refer to the performance optimization document for further guidance: [Performance Optimization](#).

1.2 Package Contents

Before installing the ConnectX-5 Socket Direct card, unpack the package and check against the below table that all parts have been sent. Check the parts for visible damage that may have occurred during shipping. The ConnectX-5 Socket Direct package content is as follows:

Table 4 - ConnectX-5 Socket Direct Package Contents

Quantity	P/N	Description
1	MCX556M-ECAT-S25	ConnectX®-5 VPI adapter card with Multi-Host Socket Direct supporting dual-socket server, EDR IB (100Gb/s) and 100GbE, dual-port QSFP28, 2x PCIe3.0 x8, tall bracket, ROHS R6
1	SA002142	Auxiliary PCIe Connection Card
1	HAR000629	25cm Slim-Line SAS Harness
1	MEC010154	Auxiliary Card PCIe Connection card short bracket
1	MEC010153	ConnectX-5 Adapter card short bracket



Use the Slim-Line SAS harness and Auxiliary PCIe Connection card that are included in the ConnectX-5 Socket Direct adapter card package contents. For MCX556M-ECAT-S25, use the 25cm Slim-line SAS cable (HAR000629) and its Auxiliary PCIe connection card (SA002142).



Note that the Adapter and Auxiliary PCIe connection cards are shipped with assembled tall brackets.

1.3 Features and Benefits

Table 5 - Features^a

<p>100Gb/s Virtual Protocol Interconnect (VPI) Adapter</p>	<p>ConnectX-5 offers the highest throughput VPI adapter, supporting EDR 100Gb/s InfiniBand and 100Gb/s Ethernet and enabling any standard networking, clustering, or storage to operate seamlessly over any converged network leveraging a consolidated software stack.</p>
<p>InfiniBand Architecture Specification v1.3 compliant</p>	<p>ConnectX-5 delivers low latency, high bandwidth, and computing efficiency for performance-driven server and storage clustering applications. ConnectX-5 is InfiniBand Architecture Specification v1.3 compliant.</p>
<p>Up to 100 Gigabit Ethernet</p>	<p>Mellanox adapters comply with the following IEEE 802.3 standards:</p> <ul style="list-style-type: none"> – 100GbE / 50GbE / 40GbE / 25GbE / 10GbE / 1GbE – IEEE 802.3bj, 802.3bm 100 Gigabit Ethernet – IEEE 802.3by, Ethernet Consortium25, 50 Gigabit Ethernet, supporting all FEC modes – IEEE 802.3ba 40 Gigabit Ethernet – IEEE 802.3by 25 Gigabit Ethernet – IEEE 802.3ae 10 Gigabit Ethernet – IEEE 802.3ap based auto-negotiation and KR startup– Proprietary Ethernet protocols (20/40GBASE-R2, 50GBASE-R4) – IEEE 802.3ad, 802.1AX Link Aggregation – IEEE 802.1Q, 802.1P VLAN tags and priority – IEEE 802.1Qau (QCN) – Congestion Notification – IEEE 802.1Qaz (ETS) – IEEE 802.1Qbb (PFC) – IEEE 802.1Qbg – IEEE 1588v2 – Jumbo frame support (9.6KB)
<p>InfiniBand EDR</p>	<p>A standard InfiniBand data rate, where each lane of a 4X port runs a bit rate of 25.78125Gb/s with a 64b/66b encoding, resulting in an effective bandwidth of 100Gb/s.</p>
<p>Memory</p>	<p>PCI Express - stores and accesses InfiniBand and/or Ethernet fabric connection information and packet data.</p>
<p>Overlay Networks</p>	<p>In order to better scale their networks, data center operators often create overlay networks that carry traffic from individual virtual machines over logical tunnels in encapsulated formats such as NVGRE and VXLAN. While this solves network scalability issues, it hides the TCP packet from the hardware offloading engines, placing higher loads on the host CPU. ConnectX-5 effectively addresses this by providing advanced NVGRE and VXLAN hardware offloading engines that encapsulate and de-capsulate the overlay protocol.</p>

Table 5 - Features^a

<p>RDMA and RDMA over Converged Ethernet (RoCE)</p>	<p>ConnectX-5, utilizing IBTA RDMA (Remote Data Memory Access) and RoCE (RDMA over Converged Ethernet) technology, delivers low-latency and high-performance over Band and Ethernet networks. Leveraging data center bridging (DCB) capabilities as well as ConnectX-5 advanced congestion control hardware mechanisms, RoCE provides efficient low-latency RDMA services over Layer 2 and Layer 3 networks.</p>
<p>Mellanox PeerDirect™</p>	<p>PeerDirect™ communication provides high efficiency RDMA access by eliminating unnecessary internal data copies between components on the PCIe bus (for example, from GPU to CPU), and therefore significantly reduces application run time. ConnectX-5 advanced acceleration technology enables higher cluster efficiency and scalability to tens of thousands of nodes.</p>
<p>CPU Offload</p>	<p>Adapter functionality enabling reduced CPU overhead allowing more available CPU for computation tasks.</p> <p>Open VSwitch (OVS) offload using ASAP²(™)</p> <ul style="list-style-type: none"> • Flexible match-action flow tables • Tunneling encapsulation / decapsulation
<p>Quality of Service (QoS)</p>	<p>Support for port-based Quality of Service enabling various application requirements for latency and SLA.</p>
<p>Hardware-based I/O Virtualization</p>	<p>ConnectX-5 provides dedicated adapter resources and guaranteed isolation and protection for virtual machines within the server.</p>
<p>Storage Acceleration</p>	<p>A consolidated compute and storage network achieves significant cost-performance advantages over multi-fabric networks. Standard block and file access protocols can leverage RDMA for high-performance storage access.</p> <ul style="list-style-type: none"> • NVMe over Fabric offloads for target machine • Erasure Coding • T10-DIF Signature Handover
<p>SR-IOV</p>	<p>ConnectX-5 SR-IOV technology provides dedicated adapter resources and guaranteed isolation and protection for virtual machines (VM) within the server.</p>
<p>High-Performance Accelerations</p>	<ul style="list-style-type: none"> • Tag Matching and Rendezvous Offloads • Adaptive Routing on Reliable Transport • Burst Buffer Offloads for Background Checkpointing

a. This section describes hardware features and capabilities. Please refer to the driver release notes for feature availability. See [Related Documentation](#).

1.4 Operating Systems/Distributions

- RHEL/CentOS
- Windows
- FreeBSD
- VMware
- OpenFabrics Enterprise Distribution (OFED)
- OpenFabrics Windows Distribution (WinOF-2)

1.5 Connectivity

- Interoperable with 1/10/25/40/50/100 Gb/s Ethernet switches
- Passive copper cable with ESD protection
- Powered connectors for optical and active cable support

1.6 Manageability

Socket Direct technology maintains support for manageability through a BMC. The Socket Direct PCIe stand-up adapter can be connected to a BMC using MCTP over SMBus or MCTP over PCIe protocols as if it is a standard Mellanox PCIe stand-up adapter. For configuring the adapter for the specific manageability solution in use by the server, please contact Mellanox Support.

2 Interfaces

Each adapter card includes the following interfaces:

- “InfiniBand Interface”
- “Ethernet SFP28 Interface”
- “PCI Express Interface”
- “LED Interface”

The adapter card include special circuits to protect from ESD shocks to the card/server when plugging copper cables.

2.1 InfiniBand Interface

The network ports of the ConnectX®-5 adapter cards are compliant with the *InfiniBand Architecture Specification, Release 1.3*. InfiniBand traffic is transmitted through the cards' QSFP28 connectors.

2.2 Ethernet SFP28 Interface

The network ports of the ConnectX®-5 adapter card are compliant with the IEEE 802.3 Ethernet standards listed in [Table 5, “Features,” on page 12](#). Ethernet traffic is transmitted through the cards' SFP28 connectors.

2.3 PCI Express Interface

The ConnectX®-5 adapter card supports PCI Express Gen 3.0 (1.1 and 2.0 compatible) two PCIe x8 edge connectors; x8 edge connector on the adapter card and x8 edge connector on the auxiliary PCIe connection card accessible through the Slim Line-SAS cable. The device can be either a master initiating the PCI Express bus operations, or a slave responding to PCI bus operations.

The following lists PCIe interface features:

- PCIe Gen 3.0 compliant, 2.0 and 1.1 compatible
- 2.5, 5.0, or 8.0 GT/s link rate x168
- Support for MSI/MSI-X mechanisms

2.4 LED Interface

There is one bi-color I/O LED per port located on the adapter card. For LED specifications, please refer to [Section 7.3, “Adapter Card LED Operations”, on page 62](#).

3 Hardware Installation

3.1 System Requirements

3.1.1 Hardware



Unless otherwise specified, Mellanox products are designed to work in an environmentally controlled data center with low levels of gaseous and dust (particulate) contamination.

The operation environment should meet severity level G1 as per ISA 71.04 for gaseous contamination and ISO 14644-1 class 8 for cleanliness level.

A system with adjacent dual PCIe x8 slots is required for installing the card. For dual socket servers, this card brings additional benefits of lower latency and lower CPU utilization when one slot is connected to one socket and the other slot is connected to the other socket. The below list specifies the servers tested with the adapter. For specific server compatibility, please contact Mellanox Support.

- Dell PowerEdge_R720
- SuperMicro SYS-1027R-72RFTP.

3.1.2 Operating Systems/Distributions

Please refer to [Section 1.4, “Operating Systems/Distributions”](#), on page 14.

3.1.3 Software Stacks

Mellanox OpenFabric software package MLNX_OFED for Linux, WinOF-2 for Windows. See [Chapter 4, “Driver Installation”](#).

3.2 Safety Precautions



The adapter is being installed in a system that operates with voltages that can be lethal. Before opening the case of the system, observe the following precautions to avoid injury and prevent damage to system components.

1. Remove any metallic objects from your hands and wrists.
2. Make sure to use only insulated tools.
3. Verify that the system is powered off and is unplugged.
4. It is strongly recommended to use an ESD strap or other antistatic devices.

3.3 Pre-Installation Checklist

1. Verify that your system meets the hardware and software requirements stated above.

2. Shut down your system if active.
3. After shutting down the system, turn off power and unplug the cord.
4. Remove the card from its package.
5. Please note that the card must be placed on an antistatic surface.
6. Check the card for visible signs of damage. Do not attempt to install the card if damaged.

3.4 Bracket Installation Instructions

The card and auxiliary connection card are usually shipped with tall brackets installed. If this form factor is suitable for your requirements, you can skip the remainder of this section and move to [Section 3.5, “Card Installation Instructions”, on page 18](#). If you need to replace them with the short bracket that is included in the shipping box, please follow the instructions in this section.



Due to risk of damaging the EMI gasket, it is not recommended to replace the bracket more than three times.

To replace the brackets you will need the following parts:

- The new brackets of the proper height
- The 2 screws saved from the removal of the brackets

3.4.1 Removing the Existing Bracket

1. Remove the two screws holding the bracket in place. The bracket comes loose from the card.



Be careful not to put stress on the LEDs on the adapter card.

2. Save the two screws.

3.4.2 Installing the New Bracket

1. Place the bracket onto the card until the screw holes line up.



Do not force the bracket onto the adapter card. You may have to gently push the LEDs using a small screwdriver to align the LEDs with the holes in the bracket.

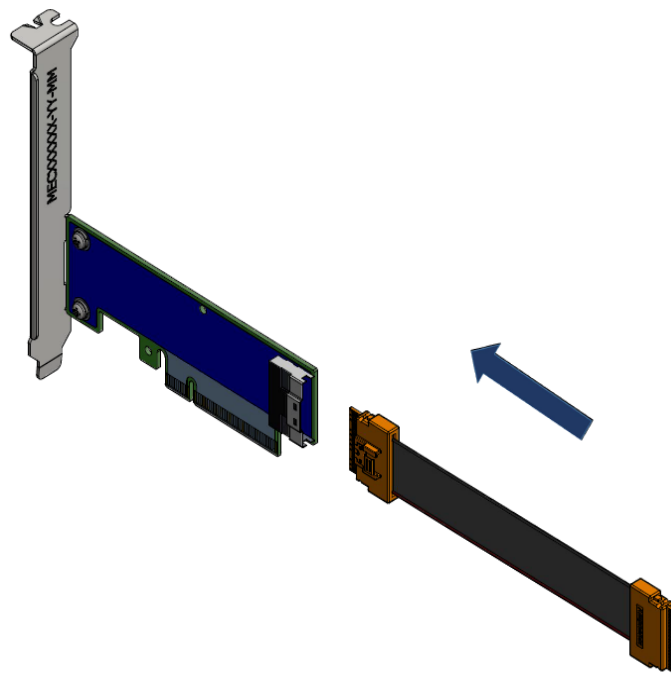
2. Screw on the bracket using the screws saved from the bracket removal procedure above.
3. Make sure that the LEDs on the adapter card are aligned onto the bracket holes.
4. Use a torque driver to apply up to 2 lbs-in torque on the screws

3.5 Card Installation Instructions



Please note that the following figures are for illustration purposes only.

1. Before installing the card, make sure that the system is off and the power cord is not connected to the server. Please follow proper electrical grounding procedures.
2. Open the system case.
3. Connect the slim-line SAS connector (male) on the slim line SAS cable to the female connector on the auxiliary PCIe connection card.



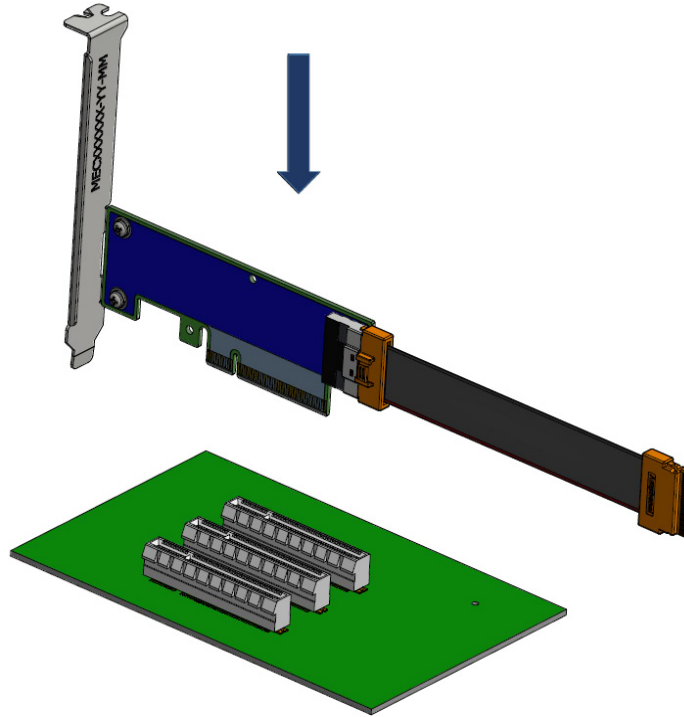
Use the Slim-Line SAS harness and auxiliary PCIe connection card that are included in the ConnectX-5 Socket Direct adapter card package contents. For installing MCX556M-ECAT-S25, use the 25cm Slim-line SAS cable (HAR000629) and its Auxiliary PCIe connection card (SA002142). Please see [Section 1.2, “Package Contents”, on page 11](#).

4. Locate two available PCI Express slots on the server, one for the adapter card and one for the auxiliary PCIe connection card.



For optimal thermal performance, it is preferable to place the auxiliary PCIe connection card component-side facing the adapter card’s print-side.

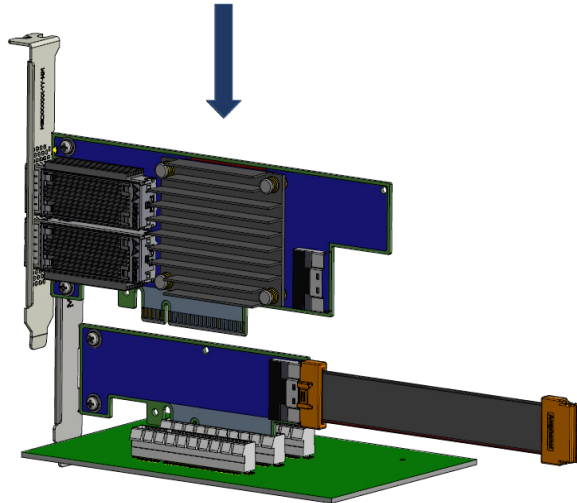
5. Applying even pressure at both corners of the card, insert the auxiliary PCIe connection card into the PCI Express slot until firmly seated.



Do not use excessive force when seating the card, as this may damage the system or the auxiliary PCIe connection card.

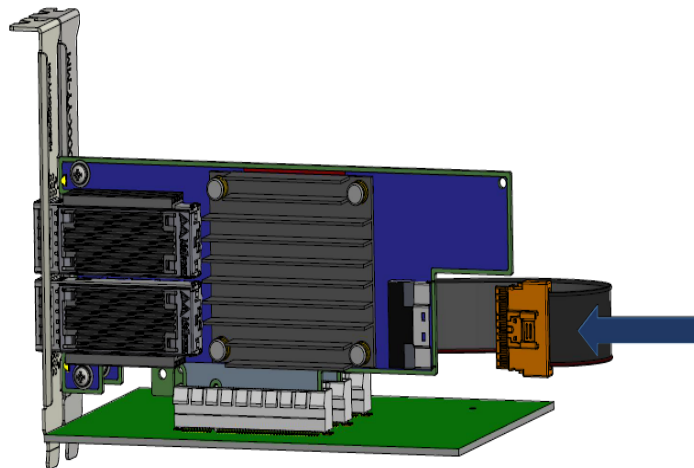
6. Secure the auxiliary PCIe connection card using the server's retention mechanisms.

7. Applying even pressure at both corners of the card, insert the adapter card into the PCI Express slot adjacent to the auxiliary PCIe connection card until firmly seated.

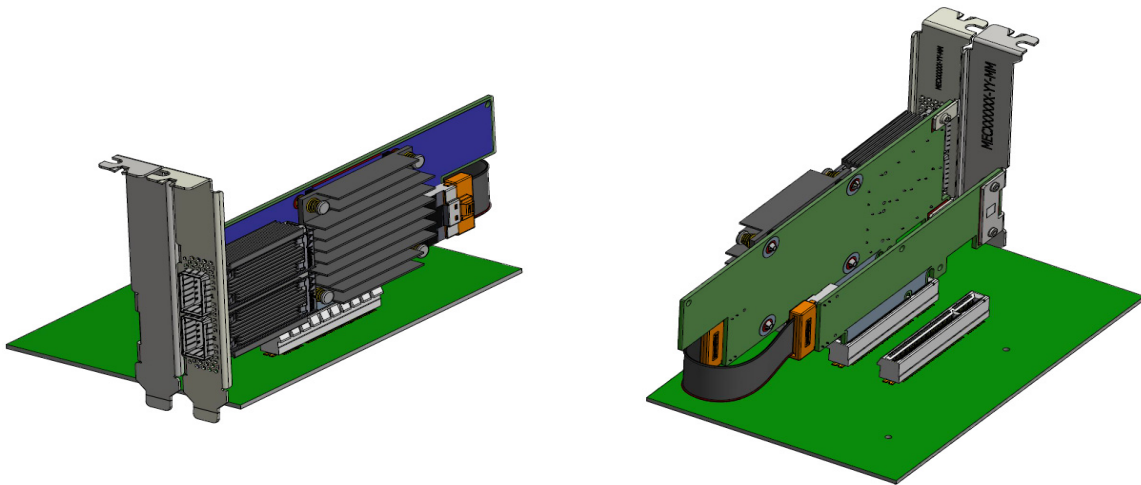


Do not use excessive force when seating the card, as this may damage the system or the adapter.

8. Secure the adapter card using the server's retention mechanisms.
9. Connect the slim line-SAS cable to the connector on the adapter card.



10. Close the system case.



3.6 Cables and Modules

To obtain the list of supported Mellanox cables for your adapter, please refer to the [Cables Reference Table](#).

3.6.1 Cable Installation

1. All cables can be inserted or removed with the unit powered on.
2. To insert a cable, press the connector into the port receptacle until the connector is firmly seated.
 - a. Support the weight of the cable before connecting the cable to the adapter card. Do this by using a cable holder or tying the cable to the rack.
 - b. Determine the correct orientation of the connector to the card before inserting the connector. Do not try and insert the connector upside down. This may damage the adapter card.
 - c. Insert the connector into the adapter card. Be careful to insert the connector straight into the cage. Do not apply any torque, up or down, to the connector cage in the adapter card.
 - d. Make sure that the connector locks in place.



When installing cables make sure that the latches engage.



Always install and remove cables by pushing or pulling the cable and connector in a straight line with the card.

3. After inserting a cable into a port, the Amber LED indicator will light when the physical connection is established (that is, when the unit is powered on and a cable is plugged into the port with the other end of the connector plugged into a functioning port). See [Section 7.3, “Adapter Card LED Operations”](#), on page 62.
4. After plugging in a cable, lock the connector using the latching mechanism particular to the cable vendor. When data is being transferred the Green LED will blink. See [Section 7.3, “Adapter Card LED Operations”](#), on page 62.
5. Care should be taken as not to impede the air exhaust flow through the ventilation holes. Use cable lengths which allow for routing horizontally around to the side of the chassis before bending upward or downward in the rack.
6. To remove a cable, disengage the locks and slowly pull the connector away from the port receptacle. LED indicator will turn off when the cable is unseated.

3.7 Adapter Card Disassembly Instructions

3.7.1 Safety Precautions



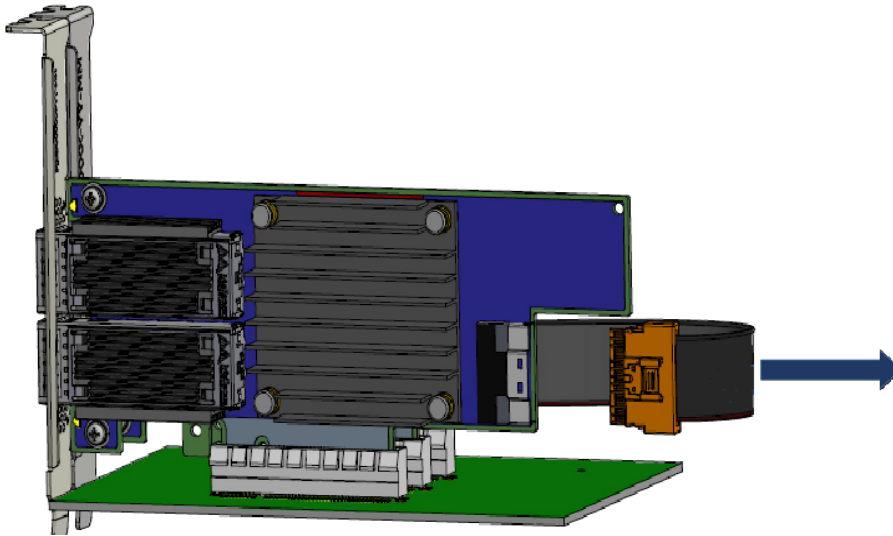
The adapter card and auxiliary PCIe connection cards are installed in a system that operates with voltages that can be lethal. Before un-installing the cards, please observe the following precautions to avoid injury and prevent damage to system components.

1. Remove any metallic objects from your hands and wrists.
2. It is strongly recommended to use an ESD strap or other antistatic devices.
3. Turn off the system and disconnect the power cord from the server.

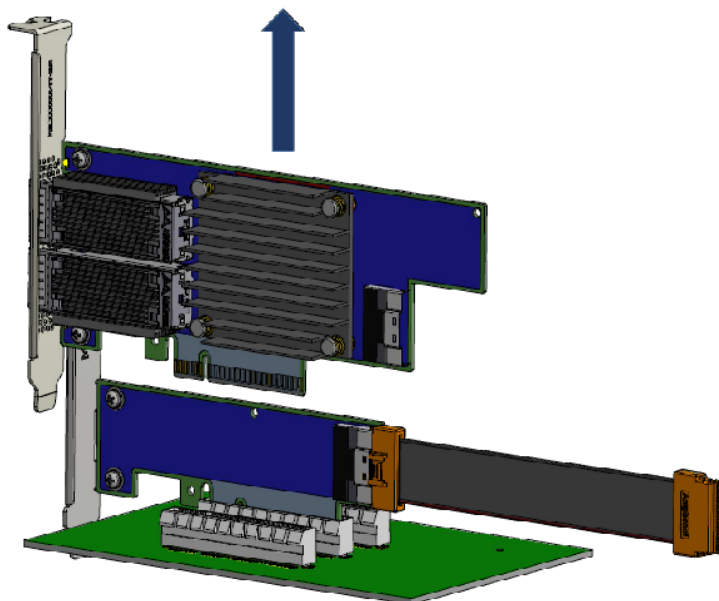
3.7.2 Un-Installing the Cards

1. Verify that the system is powered off and unplugged.
2. Wait 30 seconds.

3. Disconnect the slim-line SAS cable from the connector on the adapter card.

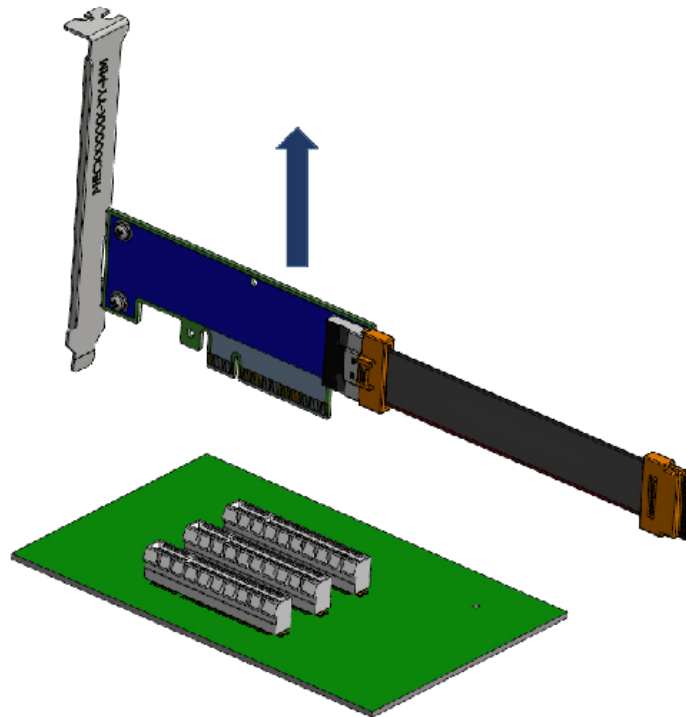


4. Disengage the retention mechanisms (clips or screws) on adapter card.
5. Holding the card from its center, gently pull the adapter card from the PCI Express slot.

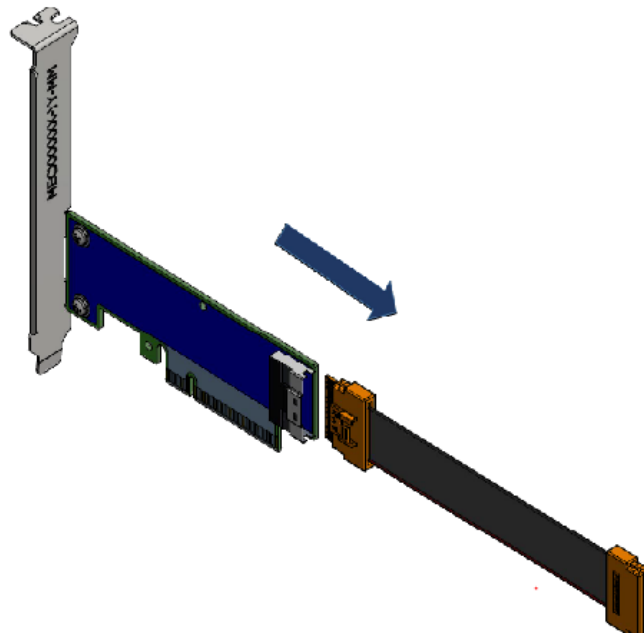


6. Disengage the retention mechanisms (clips or screws) on the auxiliary PCIe connection card.

7. Holding the card from its center, gently pull the auxiliary PCIe connection card from the PCI Express slot.



8. Disconnect the slim-line SAS cable from the connector on the auxiliary PCIe connection card.



3.8 Identify the Card in Your System

3.8.1 On Windows

1. Open Device Manager on the server. Click Start => Run, and then enter “devmgmt.msc”.
2. Expand System Devices and locate your Mellanox ConnectX-5 adapter card.
3. Right click the mouse on your adapter's row and select Properties to display the adapter card properties window.
4. Click the Details tab and select **Hardware Ids** (Windows 2012/R2/2016) from the Properties pull-down menu.
5. In the Value display box, check the fields VEN and DEV (fields are separated by ‘&’). In the display example above, notice the sub-string “PCI\VEN_15B3&DEV_1003”: VEN is equal to 0x15B3 – this is the Vendor ID of Mellanox Technologies; and DEV is equal to 1018 (for ConnectX-5) – this is a valid Mellanox Technologies PCI Device ID.



If the PCI device does not have a Mellanox adapter ID, return to Step 2 to check another device.



The list of Mellanox Technologies PCI Device IDs can be found in the PCI ID repository at <http://pci-ids.ucw.cz/read/PC/15b3>.

3.8.2 On Linux

Get the device location on the PCI bus by running `lspci` and locating lines with the string “Mellanox Technologies”:

```
lspci |grep -i Mellanox
Network controller: Mellanox Technologies MT28800 Family [ConnectX-5]
```

4 Driver Installation

4.1 Linux

For Linux, download and install the latest OpenFabrics Enterprise Distribution (OFED) software package available via the Mellanox web site at: <http://www.mellanox.com> => Products => Software => InfiniBand/VPI Drivers => Linux SW/Drivers => Download. This chapter describes how to install and test the Mellanox OFED for Linux package on a single host machine with Mellanox ConnectX-5 adapter hardware installed.

4.1.1 Hardware and Software Requirements

Table 6 - Hardware and Software Requirements

Requirements	Description
Platforms	<ul style="list-style-type: none"> A server platform with an adapter card based on one of the following Mellanox Technologies' InfiniBand/VP HCA devices: MT4119 ConnectX®-5 (VPI, IB, EN) (firmware: fw-ConnectX5).
Required Disk Space for Installation	1GB
Device ID	For the latest list of device IDs, please visit Mellanox website.
Operating System	Linux operating system. For the list of supported operating system distributions and kernels, please refer to the Mellanox OFED Release Notes file.
Installer Privileges	The installation requires administrator (root) privileges on the target machine.

4.1.2 Downloading Mellanox OFED

Step 1. Verify that the system has a Mellanox network adapter (HCA/NIC) installed.

```
[root@mftqa-009 ~]# lspci |grep mellanox -i
05:00.0 Infiniband controller: Mellanox Technologies MT27800 Family [ConnectX-5]
05:00.1 Infiniband controller: Mellanox Technologies MT27800 Family [ConnectX-5]
82:00.0 Infiniband controller: Mellanox Technologies MT27800 Family [ConnectX-5]
82:00.1 Infiniband controller: Mellanox Technologies MT27800 Family [ConnectX-5]
```

In the output example above, the first two rows indicate that one card is installed in a PCI slot with PCI Bus address 05 (hexadecimal), PCI Device number 00 and PCI Function number 0 and 1. The other card is installed in a PCI slot with PCI Bus address 82 (hexadecimal), PCI Device number 00 and PCI Function number 0 and 1.

Since the two PCIe cards are installed in two PCIe slots, each card gets a unique PCI Bus and Device number. Each of the PCIe x8 busses sees two network ports; in effect, the two 100Gb/s physical ports of the ConnectX-5 Socket Direct Adapter are viewed as four net-devices by the system.

Step 2. Download the ISO image to your host.

The image's name has the format `MLNX_OFED_LINUX-<ver>-<OS label><CPU arch>.iso`. You can download it from <http://www.mellanox.com> --> Products --> Software --> InfiniBand/VPI Drivers --> Mellanox OFED Linux (MLNX_OFED).

Step a. Scroll down to the Download wizard, and click the Download tab.

Step b. Choose your relevant package depending on your host operating system.

Step c. Click the desired ISO/tgz package.

Step d. To obtain the download link, accept the End User License Agreement (EULA).

Step 3. Use the `md5sum` utility to confirm the file integrity of your ISO image. Run the following command and compare the result to the value provided on the download page.

```
md5sum MLNX_OFED_LINUX-<ver>-<OS label>.iso
```

4.1.3 Installing Mellanox OFED

4.1.3.1 Installation Script

The installation script, `mlnxofedinstall`, performs the following:

- Discovers the currently installed kernel
- Uninstalls any software stacks that are part of the standard operating system distribution or another vendor's commercial stack
- Installs the `MLNX_OFED_LINUX` binary RPMs (if they are available for the current kernel)
- Identifies the currently installed InfiniBand and Ethernet network adapters and automatically¹ upgrades the firmware

Note: If you wish to perform a firmware upgrade using customized FW binaries, you can provide a path to the folder that contains the FW binary files, by running `--fw-image-dir`. Using this option, the FW version embedded in the `MLNX_OFED` package will be ignored.

Example:

```
./mlnxofedinstall --fw-image-dir /tmp/my_fw_bin_files
```

Usage

```
./mnt/mlnxofedinstall [OPTIONS]
```

The installation script removes all previously installed Mellanox OFED packages and re-installs from scratch. You will be prompted to acknowledge the deletion of the old packages.



Pre-existing configuration files will be saved with the extension “.conf.rpmsave”.

1. The firmware will not be updated if you run the install script with the ‘`--without-fw-update`’ option.

- If you need to install Mellanox OFED on an entire (homogeneous) cluster, a common strategy is to mount the ISO image on one of the cluster nodes and then copy it to a shared file system such as NFS. To install on all the cluster nodes, use cluster-aware tools (such as pdsh).
- If your kernel version does not match with any of the offered pre-built RPMs, you can add your kernel version by using the "mlnx_add_kernel_support.sh" script located inside the MLNX_OFED package.



On Redhat and SLES distributions with errata kernel installed there is no need to use the mlnx_add_kernel_support.sh script. The regular installation can be performed and weak-updates mechanism will create symbolic links to the MLNX_OFED kernel modules.

The "mlnx_add_kernel_support.sh" script can be executed directly from the mlnxofedinstall script. For further information, please see '--add-kernel-support' option below.



On Ubuntu and Debian distributions drivers installation use Dynamic Kernel Module Support (DKMS) framework. Thus, the drivers' compilation will take place on the host during MLNX_OFED installation. Therefore, using "mlnx_add_kernel_support.sh" is irrelevant on Ubuntu and Debian distributions.

Example

The following command will create a MLNX_OFED_LINUX ISO image for RedHat 6.3 under the /tmp directory.

```
# ./MLNX_OFED_LINUX-x.x-x-rhel6.3-x86_64/mlnx_add_kernel_support.sh -m /tmp/MLNX_OFED_ -
LINUX-x.x-x-rhel6.3-x86_64/ --make-tgz
Note: This program will create MLNX_OFED_LINUX TGZ for rhel6.3 under /tmp directory.
All Mellanox, OEM, OFED, or Distribution IB packages will be removed.
Do you want to continue?[y/N]:y
See log file /tmp/mlnx_ofed_iso.21642.log

Building OFED RPMs. Please wait...
Removing OFED RPMs...
Created /tmp/MLNX_OFED_LINUX-x.x-x-rhel6.3-x86_64-ext.tgz
```

- The script adds the following lines to /etc/security/limits.conf for the userspace components such as MPI:
 - * soft memlock unlimited
 - * hard memlock unlimited
 - These settings set the amount of memory that can be pinned by a user space application to unlimited. If desired, tune the value unlimited to a specific amount of RAM.

For your machine to be part of the InfiniBand/VPI fabric, a Subnet Manager must be running on one of the fabric nodes. At this point, Mellanox OFED for Linux has already installed the OpenSM Subnet Manager on your machine.

For the list of installation options, run: ./mlnxofedinstall --h



The DKMS (on Debian based OS) and the weak-modules (RedHat OS) mechanisms rebuild the initrd/initramfs for the respective kernel in order to add the MLNX_OFED drivers. When installing MLNX_OFED without DKMS support on Debian based OS, or without KMP support on RedHat or any other distribution, the initramfs will not be changed. Therefore, the inbox drivers may be loaded on boot. In this case, openibd service script will automatically unload them and load the new drivers that come with MLNX_OFED.

4.1.3.2 Installation Procedure

Step 1. Login to the installation machine as root.

Step 2. Mount the ISO image on your machine.

```
# mount -o ro,loop MLNX_OFED_LINUX-<ver>-<OS label>-<CPU arch>.iso /mnt
```

Step 3. Run the installation script.

```
/mnt/mlnxofedinstall
Logs dir: /tmp/MLNX_OFED_LINUX-x.x-x.logs
This program will install the MLNX_OFED_LINUX package on your machine.
Note that all other Mellanox, OEM, OFED, RDMA or Distribution IB packages will be
removed.
Those packages are removed due to conflicts with MLNX_OFED_LINUX, do not reinstall
them.

Starting MLNX_OFED_LINUX-x.x.x installation ...
.....
.....
Installation finished successfully.

Attempting to perform Firmware update...
Querying Mellanox devices firmware ...
```



For unattended installation, use the `--force` installation option while running the MLNX_OFED installation script:

```
/mnt/mlnxofedinstall --force
```



MLNX_OFED for Ubuntu should be installed with the following flags in chroot environment:

```
./mlnxofedinstall --without-dkms --add-kernel-support --kernel
<kernel version in chroot> --without-fw-update --force
```

For example:

```
./mlnxofedinstall --without-dkms --add-kernel-support --kernel
3.13.0-85-generic --without-fw-update --force
```

Note that the path to kernel sources (`--kernel-sources`) should be added if the sources are not in their default location.



In case that your machine has the latest firmware, no firmware update will occur and the installation script will print at the end of installation a message similar to the following:

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

Device Type:      ConnectX-5
Part Number:     MCX556M-ECAT-S25
Description:     ConnectX®-5 VPI adapter card with Multi-
Host Socket Direct supporting dual-socket server, EDR IB (100Gb/
s) and 100GbE, dual-port QSFP28, 2x PCIe3.0 x8, 25cm harness,
tall bracket, ROHS R6
PSID:           MT_2190110032
PCI Device Name: 0b:00.0
Base MAC:       0000e41d2d5cf810
Versions:      Current      Available
FW            16.22.0228    16.22.0228
Status:       Up to date
```



In case that your machine has an unsupported network adapter device, no firmware update will occur and one of the following error messages below will be printed. Please contact your hardware vendor for help on firmware updates.

Error message 1:

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

Device Type:      ConnectX-5
Part Number:     MCX556M-ECAT-S25
Description:     ConnectX®-5 VPI adapter card with Multi-
Host Socket Direct supporting dual-socket server, EDR IB (100Gb/
s) and 100GbE, dual-port QSFP28, 2x PCIe3.0 x8, 25cm harness,
tall bracket, ROHS R6
PSID:           MT_2190110032
PCI Device Name: 0b:00.0
Base MAC:       0000e41d2d5cf810
Versions:      Current      Available
FW            16.22.0228    N/A
Status:       No matching image found
```

Error message 2:

```
The firmware for this device is not distributed inside Mellanox
driver: 0000:01:00.0 (PSID: IBM2150110033)
To obtain firmware for this device, please contact your HW ven-
dor.
```

Step 4. If the installation script has performed a firmware update on your network adapter, complete the step relevant to your adapter card type to load the firmware:

- Socket Direct or Multi-Host cards - perform a cold reboot (power cycle)

Otherwise, restart the driver by running: `"/etc/init.d/openibd restart"`

Step 5. (InfiniBand only) Run the `hca_self_test.ofed` utility to verify whether or not the InfiniBand link is up. The utility also checks for and displays additional information such as:

- HCA firmware version
- Kernel architecture
- Driver version
- Number of active HCA ports along with their states
- Node GUID

For more details on `hca_self_test.ofed`, see the file `docs/readme_and_user_manual/hca_self_test.readme`.

After installation completion, information about the Mellanox OFED installation, such as prefix, kernel version, and installation parameters can be retrieved by running the command `/etc/infiniband/info`.

Most of the Mellanox OFED components can be configured or reconfigured after the installation, by modifying the relevant configuration files. See the relevant chapters in this manual for details.

The list of the modules that will be loaded automatically upon boot can be found in the `/etc/infiniband/openib.conf` file.

4.1.3.3 Installation Results

Table 7 - Installation Results

Software	<ul style="list-style-type: none"> • Most of MLNX_OFED packages are installed under the “/usr” directory except for the following packages which are installed under the “/opt” directory: <ul style="list-style-type: none"> • fca and ibutils • The kernel modules are installed under <ul style="list-style-type: none"> • /lib/modules/<code>uname -r</code>/updates on SLES and Fedora Distributions • /lib/modules/<code>uname -r</code>/extra/mlnx-ofa_kernel on RHEL and other RedHat like Distributions
Firmware	<ul style="list-style-type: none"> • The firmware of existing network adapter devices will be updated if the following two conditions are fulfilled: <ul style="list-style-type: none"> • The installation script is run in default mode; that is, without the option ‘--without-fw-update’ • The firmware version of the adapter device is older than the firmware version included with the Mellanox OFED ISO image <p>Note: If an adapter’s Flash was originally programmed with an Expansion ROM image, the automatic firmware update will also burn an Expansion ROM image.</p> • In case that your machine has an unsupported network adapter device, no firmware update will occur and the error message below will be printed. The firmware for this device is not distributed inside Mellanox driver: 0000:01:00.0 (PSID: IBM2150110033) To obtain firmware for this device, please contact your HW vendor.

4.1.3.4 Installation Logging

While installing MLNX_OFED, the install log for each selected package will be saved in a separate log file.

The path to the directory containing the log files will be displayed after running the installation script in the following format: "Logs dir: /tmp/MLNX_OFED_LINUX-<version>.<PID>.logs".

Example:

```
Logs dir: /tmp/MLNX_OFED_LINUX-x.x-x.logs
```

4.1.3.5 openibd Script

As of MLNX_OFED v2.2-1.0.0 the openibd script supports pre/post start/stop scripts:

This can be controlled by setting the variables below in the /etc/infiniband/openibd.conf file.

```
OPENIBD_PRE_START
OPENIBD_POST_START
OPENIBD_PRE_STOP
OPENIBD_POST_STOP
```

Example:

```
OPENIBD_POST_START=/sbin/openibd_post_start.sh
```



An example of OPENIBD_POST_START script for activating all interfaces is provided in the MLNX_OFED package under the docs/scripts/openibd-post-start-configure-interfaces/ folder.

4.1.3.6 Driver Load Upon System Boot

Upon system boot, the Mellanox drivers will be loaded automatically.

➤ **To prevent automatic load of the Mellanox drivers upon system boot:**

Step 1. Add the following lines to the `"/etc/modprobe.d/mlnx.conf"` file.

```
blacklist mlx4_core
blacklist mlx4_en
blacklist mlx5_core
blacklist mlx5_ib
```

Step 2. Set `"ONBOOT=no"` in the `"/etc/infiniband/openib.conf"` file.

Step 3. If the modules exist in the `initramfs` file, they can automatically be loaded by the kernel. To prevent this behavior, update the `initramfs` using the operating systems' standard tools.

Note: The process of updating the `initramfs` will add the blacklists from step 1, and will prevent the kernel from loading the modules automatically.

4.1.3.7 mlnxofedinstall Return Codes

The table below lists the `mlnxofedinstall` script return codes and their meanings.

Table 8 - mlnxofedinstall Return Codes

Return Code	Meaning
0	The Installation ended successfully
1	The installation failed
2	No firmware was found for the adapter device
22	Invalid parameter
28	Not enough free space
171	Not applicable to this system configuration. This can occur when the required hardware is not present on the system.
172	Prerequisites are not met. For example, missing the required software installed or the hardware is not configured correctly.
173	Failed to start the <code>mst</code> driver

4.1.3.8 Network Port Configuration and Basic Performance Verification

Step 1. Show installed Mellanox ConnectX-5 Socket Direct cards using `ibdev2netdev` command.

Note: For ConnectX-5 Socket Direct adapters, use `ibdev2netdev` to display the installed card and the mapping of logical ports to physical ports. Example:

```
[root@gen-1-vrt-203 ~]# ibdev2netdev -v | grep -i MCX556M-ECAT-S25
0000:84:00.0 mlx5_10 (MT4119 - MCX556M-ECAT-S25SN) CX556M - ConnectX-5 QSFP28 fw 16.22.0228
port 1 (DOWN ) ==> p2p1 (Down)
0000:84:00.1 mlx5_11 (MT4119 - MCX556M-ECAT-S25SN) CX556M - ConnectX-5 QSFP28 fw 16.22.0228
port 1 (DOWN ) ==> p2p2 (Down)
0000:05:00.0 mlx5_2 (MT4119 - MCX556M-ECAT-S25SN) CX556M - ConnectX-5 QSFP28 fw 16.22.0228
port 1 (DOWN ) ==> p5p1 (Down)
0000:05:00.1 mlx5_3 (MT4119 - MCX556M-ECAT-S25SN) CX556M - ConnectX-5 QSFP28 fw 16.22.0228
port 1 (DOWN ) ==> p5p2 (Down)
```

Note that each PCI card of ConnectX-5 Socket Direct has a different PCI address. In the output example above, the first two rows indicate that one card is installed in a PCI slot with PCI Bus address 84 (hexadecimal), and PCI Device number 00, and PCI Function number 0 and 1. RoCE assigned `mlx5_10` as the logical port, which is the same as netdevice `p2p1`, and both are mapped to physical port of PCI function 0000:84:00.0.

Note also that RoCE logical port `mlx5_2` of the second PCI card (PCI Bus address 05) and netdevice `p5p1` are mapped to physical port of PCI function 0000:05:00.0, which is the same physical port of PCI function 0000:84:00.0.

MT4119 is the PCI Device ID of the Mellanox ConnectX-5 adapters family.

Step 2. Check to which NUMA each netdevice is connected to:

```
[root@gen-1-vrt-203 ~]# cat /sys/class/net/p2p1/device/numa_node
0
[root@gen-1-vrt-203 ~]# cat /sys/class/net/p5p1/device/numa_node
1
```

- Step 3.** Assign/obtain IP addresses to the 4 netdevices. The following commands assign IP addresses.

```
[root@gen-l-vrt-203 ~]# ifconfig p2p1 2.1.203.1
[root@gen-l-vrt-203 ~]# ifconfig p2p2 3.1.203.1
[root@gen-l-vrt-203 ~]# ifconfig p5p1 1.1.203.1
[root@gen-l-vrt-203 ~]# ifconfig p5p2 4.1.203.1
```

- Step 4.** Verify the IP assignments and show MAC addresses.

```
[root@gen-l-vrt-203 ~]# ifconfig

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1 (Local Loopback)
    RX packets 48 bytes 3564 (3.4 KiB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 48 bytes 3564 (3.4 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

p2p1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 2.1.203.1 netmask 255.0.0.0 broadcast 2.255.255.255
    inet6 fe80::268a:7ff:fe9d:4624 prefixlen 64 scopeid 0x20<link>
    ether 24:8a:07:9d:46:24 txqueuelen 1000 (Ethernet)
    RX packets 745184235 bytes 1084195232540 (1009.7 GiB)
    RX errors 0 dropped 33118 overruns 0 frame 0
    TX packets 21605713 bytes 1428417776 (1.3 GiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

p5p1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 1.1.203.1 netmask 255.0.0.0 broadcast 1.255.255.255
    inet6 fe80::268a:7ff:fe9d:4628 prefixlen 64 scopeid 0x20<link>
    ether 24:8a:07:9d:46:28 txqueuelen 1000 (Ethernet)
    RX packets 788009522 bytes 1144066044824 (1.0 TiB)
    RX errors 0 dropped 6431 overruns 0 frame 0
    TX packets 21167209 bytes 1400390004 (1.3 GiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
.
.
.
```

Step 5. Verify link is up and max speed rate.

```
[root@gen-1-vrt-203 ~]# ibstat mlx5_10
CA 'mlx5_10'
  CA type: MT4119
  Number of ports: 1
  Firmware version: 16.22.0228
  Hardware version: 0
  Node GUID: 0x248a0703009d4624
  System image GUID: 0x248a0703009d4624
  Port 1:
    State: Active
    Physical state: LinkUp
    Rate: 100
    Base lid: 0
    LMC: 0
    SM lid: 0
    Capability mask: 0x04010000
    Port GUID: 0x268a07fffe9d4624
    Link layer: Ethernet
```

Step 6. Run Netperf / iperf benchmark to see the network transfer rate.

```
[root@gen-1-vrt-203 ~]# mlx_perf -i p5p1 -t 3 -c 1 | grep rx_bytes ; mlx_perf -i
p2p1 -t 3 -c 1 | grep rx_bytes
  rx_bytes: 5,597,603,282 Bps    = 44,780.82 Mbps
  rx_bytes_phy: 12,004,697,694 Bps = 96,037.58 Mbps
  rx_bytes: 5,919,563,331.33 Bps = 47,356.50 Mbps
  rx_bytes_phy: 12,031,980,708 Bps = 96,255.84 Mbps
```



Please refer to the [Getting Started with Socket Direct ConnectX-5 Adapters on a RoCE Network](#) further guidance:

[Getting Started with Socket Direct ConnectX-5 Adapters on a RoCE Network](#)

4.1.4 Uninstalling Mellanox OFED

Use the script `/usr/sbin/ofed_uninstall.sh` to uninstall the Mellanox OFED package. The script is part of the `ofed-scripts` RPM.

4.1.5 Installing MLNX_OFED Using YUM

This type of installation is applicable to RedHat/OL, Fedora, XenServer Operating Systems.

4.1.5.1 Setting up MLNX_OFED YUM Repository

Step 1. Log into the installation machine as root.

- Step 2.** Mount the ISO image on your machine and copy its content to a shared location in your network.

```
# mount -o ro,loop MLNX_OFED_LINUX-<ver>-<OS label>-<CPU arch>.iso /mnt
```

- Step 3.** Download and install Mellanox Technologies GPG-KEY:

The key can be downloaded via the following link:

<http://www.mellanox.com/downloads/ofed/RPM-GPG-KEY-Mellanox>

```
# wget http://www.mellanox.com/downloads/ofed/RPM-GPG-KEY-Mellanox
--2014-04-20 13:52:30-- http://www.mellanox.com/downloads/ofed/RPM-GPG-KEY-Mellanox
Resolving www.mellanox.com... 72.3.194.0
Connecting to www.mellanox.com|72.3.194.0|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 1354 (1.3K) [text/plain]
Saving to: ?RPM-GPG-KEY-Mellanox?

100%[=====] 1,354      --.-K/s   in 0s

2014-04-20 13:52:30 (247 MB/s) - ?RPM-GPG-KEY-Mellanox? saved [1354/1354]
```

- Step 4.** Install the key.

```
# sudo rpm --import RPM-GPG-KEY-Mellanox
warning: rpmts_HdrFromFdno: Header V3 DSA/SHA1 Signature, key ID 6224c050: NOKEY
Retrieving key from file:///repos/MLNX_OFED/<MLNX_OFED file>/RPM-GPG-KEY-Mellanox
Importing GPG key 0x6224C050:
  Userid: "Mellanox Technologies (Mellanox Technologies - Signing Key v2) <support@mellanox.com>"
  From   : /repos/MLNX_OFED/<MLNX_OFED file>/RPM-GPG-KEY-Mellanox
Is this ok [y/N]:
```

- Step 5.** Check that the key was successfully imported.

```
# rpm -q gpg-pubkey --qf '%{NAME}-%{VERSION}-%{RELEASE}\t%{SUMMARY}\n' | grep Mellanox
gpg-pubkey-a9e4b643-520791ba    gpg(Mellanox Technologies <support@mellanox.com>)
```

- Step 6.** Create a yum repository configuration file called `"/etc/yum.repos.d/mlnx_ofed.repo"` with the following content:

```
[mlnx_ofed]
name=MLNX_OFED Repository
baseurl=file:///<path to extracted MLNX_OFED package>/RPMs
enabled=1
gpgkey=file:///<path to the downloaded key RPM-GPG-KEY-Mellanox>
gpgcheck=1
```

Step 7. Check that the repository was successfully added.

```
# yum repolist
Loaded plugins: product-id, security, subscription-manager
This system is not registered to Red Hat Subscription Management. You can use subscrip-
tion-manager to register.
repo id                repo name                status
mlnx_ofed              MLNX_OFED Repository    108
rpmforge               RHEL 6Server - RPMforge.net - dag 4,597

repolist: 8,351
```

4.1.5.2 Installing MLNX_OFED Using the YUM Tool

After setting up the YUM repository for MLNX_OFED package, perform the following:

Step 1. View the available package groups by invoking:

```
# yum search mlnx-ofed-
mlnx-ofed-all.noarch : MLNX_OFED all installer package (with KMP support)
mlnx-ofed-basic.noarch : MLNX_OFED basic installer package (with KMP support)
mlnx-ofed-guest.noarch : MLNX_OFED guest installer package (with KMP support)
mlnx-ofed-hpc.noarch : MLNX_OFED hpc installer package (with KMP support)
mlnx-ofed-hypervisor.noarch : MLNX_OFED hypervisor installer package (with KMP support)
mlnx-ofed-vma.noarch : MLNX_OFED vma installer package (with KMP support)
mlnx-ofed-vma-eth.noarch : MLNX_OFED vma-eth installer package (with KMP support)
mlnx-ofed-vma-vpi.noarch : MLNX_OFED vma-vpi installer package (with KMP support)
```

Where:

mlnx-ofed-all	Installs all available packages in MLNX_OFED.
mlnx-ofed-basic	Installs basic packages required for running Mellanox cards.
mlnx-ofed-guest	Installs packages required by guest OS.
mlnx-ofed-hpc	Installs packages required for HPC.
mlnx-ofed-hypervisor	Installs packages required by hypervisor OS.
mlnx-ofed-vma	Installs packages required by VMA.
mlnx-ofed-vma-eth	Installs packages required by VMA to work over Ethernet.
mlnx-ofed-vma-vpi	Installs packages required by VMA to support VPI.

Note: MLNX_OFED provides kernel module RPM packages with KMP support for RHEL and SLES. For other operating systems, kernel module RPM packages are provided only for the operating systems' default kernel. In this case, the group RPM packages have the supported kernel version in their package's name.

Example:

```
mlnx-ofed-all-3.17.4-301.fc21.x86_64.noarch : MLNX_OFED all installer package for kernel
3.17.4-301.fc21.x86_64 (without KMP support)
mlnx-ofed-basic-3.17.4-301.fc21.x86_64.noarch : MLNX_OFED basic installer package for
kernel 3.17.4-301.fc21.x86_64 (without KMP support)
mlnx-ofed-guest-3.17.4-301.fc21.x86_64.noarch : MLNX_OFED guest installer package for
kernel 3.17.4-301.fc21.x86_64 (without KMP support)
mlnx-ofed-hpc-3.17.4-301.fc21.x86_64.noarch : MLNX_OFED hpc installer package for kernel
3.17.4-301.fc21.x86_64 (without KMP support)
```



```
mlnx-ofed-hypervisor-3.17.4-301.fc21.x86_64.noarch : MLNX_OFED hypervisor installer
package for kernel 3.17.4-301.fc21.x86_64 (without KMP support)
mlnx-ofed-vma-3.17.4-301.fc21.x86_64.noarch : MLNX_OFED vma installer package for kernel
3.17.4-301.fc21.x86_64 (without KMP support)
mlnx-ofed-vma-eth-3.17.4-301.fc21.x86_64.noarch : MLNX_OFED vma-eth installer package
for kernel 3.17.4-301.fc21.x86_64 (without KMP support)
mlnx-ofed-vma-vpi-3.17.4-301.fc21.x86_64.noarch : MLNX_OFED vma-vpi installer package
for kernel 3.17.4-301.fc21.x86_64 (without KMP support)
```

If you have an operating system different than RHEL or SLES, or you have installed a kernel that is not supported by default in MLNX_OFED, you can use the `mlnx_add_kernel_support.sh` script to build MLNX_OFED for your kernel.

The script will automatically build the matching group RPM packages for your kernel so that you can still install MLNX_OFED via yum.

Please note that the resulting MLNX_OFED repository will contain unsigned RPMs, therefore, you should set `'gpgcheck=0'` in the repository configuration file.

Step 2. Install the desired group.

```
# yum install mlnx-ofed-all
Loaded plugins: langpacks, product-id, subscription-manager
Resolving Dependencies
--> Running transaction check
---> Package mlnx-ofed-all.noarch 0:3.1-0.1.2 will be installed
--> Processing Dependency: kmod-iser = 1.0-OFED.3.1.0.1.2.1.g832a737.rhel7ul for pack-
age: mlnx-ofed-all-3.1-0.1.2.noarch
.....
.....
qperf.x86_64 0:0.4.9-9
rds-devel.x86_64 0:2.0.7-1.12
rds-tools.x86_64 0:2.0.7-1.12
sdpNetstat.x86_64 0:1.60-26
srptools.x86_64 0:1.0.2-12

Complete!
```



Installing MLNX_OFED using the “apt-get” tool does not automatically update the firmware.

To update the firmware to the version included in MLNX_OFED package, run:

```
# apt-get install mlnx-fw-updater
```

OR:

Update the firmware to the latest version available on Mellanox Technologies’ Web site as described in

4.1.5.3 Uninstalling Mellanox OFED Using the YUM Tool

Use the script `/usr/sbin/ofed_uninstall.sh` to uninstall the Mellanox OFED package. The script is part of the `ofed-scripts` RPM.

4.1.5.4 Installing MLNX_OFED Using apt-get Tool

This type of installation is applicable to Debian and Ubuntu operating systems.

4.1.5.5 Setting up MLNX_OFED apt-get Repository

Step 1. Log into the installation machine as root.

Step 2. Extract the MLNX_OFED package on a shared location in your network.

You can download it from <http://www.mellanox.com> > Products > Software > Ethernet Drivers.

Step 3. Create an apt-get repository configuration file called `"/etc/apt/sources.list.d/mlnx_ofed.list"` with the following content:

```
# deb file:/<path to extracted MLNX_OFED package>/DEBS ./
```

Step 4. Download and install Mellanox Technologies GPG-KEY.

```
# wget -qO - http://www.mellanox.com/downloads/ofed/RPM-GPG-KEY-Mellanox | sudo apt-key add -
```

Step 5. Check that the key was successfully imported.

```
# apt-key list
pub 1024D/A9E4B643 2013-08-11
uid Mellanox Technologies <support@mellanox.com>
sub 1024g/09FCC269 2013-08-11
```

Step 6. Update the apt-get cache.

```
# sudo apt-get update
```

4.1.5.6 Installing MLNX_OFED Using the apt-get Tool

After setting up the apt-get repository for MLNX_OFED package, perform the following:

Step 1. View the available package groups by invoking:

```
# apt-cache search mlnx-ofed-
mlnx-ofed-vma-eth - MLNX_OFED vma-eth installer package (with DKMS support)
mlnx-ofed-hpc - MLNX_OFED hpc installer package (with DKMS support)
mlnx-ofed-vma-vpi - MLNX_OFED vma-vpi installer package (with DKMS support)
mlnx-ofed-basic - MLNX_OFED basic installer package (with DKMS support)
mlnx-ofed-vma - MLNX_OFED vma installer package (with DKMS support)
mlnx-ofed-all - MLNX_OFED all installer package (with DKMS support)
```

Where:

```
mlnx-ofed-all      MLNX_OFED all installer package.
mlnx-ofed-basic    MLNX_OFED basic installer package.
mlnx-ofed-vma      MLNX_OFED vma installer package.
mlnx-ofed-hpc      MLNX_OFED HPC installer package.
mlnx-ofed-vma-eth  MLNX_OFED vma-eth installer package.
mlnx-ofed-vma-vpi  MLNX_OFED vma-vpi installer package.
```

Step 2. Install the desired group.

```
# apt-get install '<group name>'
```

Example:

```
# apt-get install mlnx-ofed-all
```



Installing MLNX_OFED using the “apt-get” tool does not automatically update the firmware. To update the firmware to the version included in MLNX_OFED package, run:

```
# apt-get install mlnx-fw-updater
```

OR:
Update the firmware to the latest version available on Mellanox Technologies’ Web site as described in

4.1.5.7 Uninstalling Mellanox OFED Using the apt-get Tool

Use the script `/usr/sbin/ofed_uninstall.sh` to uninstall the Mellanox OFED package. The script is part of the `ofed-scripts` package.

4.1.6 Updating Firmware After Installation

The firmware can be updated either manually or automatically (upon system boot), as described in the sections below.

4.1.6.1 Updating the Device Manually

To update the device manually, please refer to the [OEM Firmware Download page](#).

In case that you ran the `mlnxofedinstall` script with the ‘`--without-fw-update`’ option or you are using an OEM card and now you wish to (manually) update firmware on your adapter card(s), you need to perform the steps below. The following steps are also appropriate in case that you wish to burn newer firmware that you have downloaded from Mellanox Technologies’ Web site (<http://www.mellanox.com> > Support > Firmware Download).

Step 1. Get the device’s PSID.

```
mlxfwmanager_pci | grep PSID
PSID:                MT_1210110019
```

Step 2. Download the firmware BIN file from the Mellanox website or the OEM website.

Step 3. Burn the firmware.

```
mlxfwmanager_pci -i <fw_file.bin>
```

Step 4. Reboot your machine after the firmware burning is completed.

4.1.6.2 Updating the Device Firmware Automatically upon System Boot

As of MLNX_OFED v3.1-x.x.x, firmware can be automatically updated upon system boot.

The firmware update package (`mlnx-fw-updater`) is installed in the “`/opt/mellanox/mlnx-fw-updater`” folder, and `openibd` service script can invoke the firmware update process if requested on boot.

If the firmware is updated, the following message is printed to the system's standard logging file:

```
fw_updater: Firmware was updated. Please reboot your system for the changes to take effect.
```

Otherwise, the following message is printed:

```
fw_updater: Didn't detect new devices with old firmware.
```

Please note, this feature is disabled by default. To enable the automatic firmware update upon system boot, set the following parameter to "yes" `"RUN_FW_UPDATER_ONBOOT=yes"` in the `openibd` service configuration file `"/etc/infiniband/openib.conf"`.

You can opt to exclude a list of devices from the automatic firmware update procedure. To do so, edit the configurations file `"/opt/mellanox/mlnx-fw-updater/mlnx-fw-updater.conf"` and provide a comma separated list of PCI devices to exclude from the firmware update.

Example:

```
MLNX_EXCLUDE_DEVICES="00:05.0,00:07.0"
```

4.1.7 UEFI Secure Boot

All kernel modules included in `MLNX_OFED` for RHEL7 and SLES12 are signed with x.509 key to support loading the modules when Secure Boot is enabled.

4.1.7.1 Enrolling Mellanox's x.509 Public Key On your Systems

In order to support loading `MLNX_OFED` drivers when an OS supporting Secure Boot boots on a UEFI-based system with Secure Boot enabled, the Mellanox x.509 public key should be added to the UEFI Secure Boot key database and loaded onto the system key ring by the kernel.

Follow these steps below to add the Mellanox's x.509 public key to your system:



Prior to adding the Mellanox's x.509 public key to your system, please make sure:

- The 'mokutil' package is installed on your system
- The system is booted in UEFI mode

Step 1. Download the x.509 public key.

```
# wget http://www.mellanox.com/downloads/ofed/mlnx_signing_key_pub.der
```

Step 2. Add the public key to the MOK list using the `mokutil` utility.

You will be asked to enter and confirm a password for this MOK enrollment request.

```
# mokutil --import mlnx_signing_key_pub.der
```

Step 3. Reboot the system.

The pending MOK key enrollment request will be noticed by `shim.efi` and it will launch `Mok-Manager.efi` to allow you to complete the enrollment from the UEFI console. You will need to enter the password you previously associated with this request and confirm the enrollment. Once done, the public key is added to the MOK list, which is persistent. Once a key is in the MOK list,

it will be automatically propagated to the system key ring and subsequent will be booted when the UEFI Secure Boot is enabled.



To see what keys have been added to the system key ring on the current boot, install the 'keyutils' package and run: `#keyctl list %:.system_keyring`

4.1.7.2 Removing Signature from kernel Modules

The signature can be removed from a signed kernel module using the 'strip' utility which is provided by the 'binutils' package.

```
# strip -g my_module.ko
```

The strip utility will change the given file without saving a backup. The operation can be undo only by resigning the kernel module. Hence, we recommend backing up a copy prior to removing the signature.

➤ *To remove the signature from the MLNX_OFED kernel modules:*

Step 1. Remove the signature.

```
# rpm -qa | grep -E "kernel-ib|mlnx-ofa_kernel|iser|srp|knem|mlnx-rds|mlnx-nfs-  
rdma|mlnx-nvme|mlnx-rdma-rxe" | xargs rpm -ql | grep "\.ko$" | xargs strip -g
```

After the signature has been removed, a message as the below will no longer be presented upon module loading:

```
"Request for unknown module key 'Mellanox Technologies signing key:  
61feb074fc7292f958419386ffdd9d5ca999e403' err -11"
```

However, please note that a similar message as the following will still be presented:

```
"my_module: module verification failed: signature and/or required key missing - taint-  
ing kernel"
```

This message is presented once, only for each boot for the first module that either has no signature or whose key is not in the kernel key ring. So it's much easier to miss this message. You won't see it on repeated tests where you unload and reload a kernel module until you reboot. There is no way to eliminate this message.

Step 2. Update the initramfs on RHEL systems with the stripped modules.

```
mkinitrd /boot/initramfs-$(uname -r).img $(uname -r) --force
```

4.1.8 Performance Tuning

Depending on the application of the user's system, it may be necessary to modify the default configuration of network adapters based on the ConnectX® adapters. In case that tuning is required, please refer to the [Performance Tuning Guide for Mellanox Network Adapters](#).

4.2 Windows Driver



The snapshots in the following sections are presented for illustration purposes only. The installation interface may slightly vary, depending on the used operating system

For Windows, download and install the latest Mellanox WinOF-2 for Windows software package available via the Mellanox web site at: <http://www.mellanox.com> => Products => Software => InfiniBand/VPI Drivers => Download. Follow the installation instructions included in the download package (also available from the download page).

4.2.1 Hardware and Software Requirements

Table 9 - Hardware and Software Requirements

Description ^a	Package
Windows Server 2012 R2	MLNX_WinOF2-1_10_All_x64.exe
Windows Server 2012	MLNX_WinOF2-1_10_All_x64.exe
Windows Server 2016	MLNX_WinOF2-1_10_All_x64.exe
Windows 8.1 Client (64 bit only)	MLNX_WinOF2-1_10_All_x64.exe
Windows 10 Client (64 bit only)	MLNX_WinOF2-1_10_All_x64.exe

a. The Operating System listed above must run with administrator privileges.

4.2.2 Downloading Mellanox WinOF-2 Driver

To download the .exe according to your Operating System, please follow the steps below:

Step 1. Obtain the machine architecture.

1. To go to the Start menu, position your mouse in the bottom-right corner of the Remote Desktop of your screen.
2. Open a CMD console (Click Task Manager-->File --> Run new task, and enter CMD).
3. Enter the following command.

```
echo %PROCESSOR_ARCHITECTURE%
```

On an x64 (64-bit) machine, the output will be “AMD64”.

Step 2. Go to the Mellanox WinOF-2 web page at:

<http://www.mellanox.com> => Products => InfiniBand/VPI Drivers => Windows SW/Drivers.

Step 3. Download the image according to the architecture of your machine (see Step 1). The name of the .exe is in the following format
MLNX_WinOF2-<version>_x.exe.



Installing the incorrect .exe file is prohibited. If you do so, an error message will be displayed. For example, if you try to install a 64-bit .exe on a 32-bit machine, the wizard will display the following (or a similar) error message:

“The installation package is not supported by this processor type. Contact your vendor”

4.2.3 Installing Mellanox WinOF-2 Driver



WinOF-2 supports adapter cards based on the Mellanox ConnectX®-4 and above family of adapter IC devices only. If you have ConnectX-3 and ConnectX-3 Pro on your server, you will need to install WinOF driver.

For details on how to install WinOF driver, please refer to WinOF User Manual.

This section provides instructions for two types of installation procedures:

- “Attended Installation”

An installation procedure that requires frequent user intervention.

- “Unattended Installation”

An automated installation procedure that requires no user intervention.



Both Attended and Unattended installations require administrator privileges.

4.2.3.1 Attended Installation

The following is an example of an installation session.

Step 1. Double click the .exe and follow the GUI instructions to install MLNX_WinOF2.

Step 2. [Optional] Manually configure your setup to contain the logs option (replace “LogFile” with the relevant directory):.

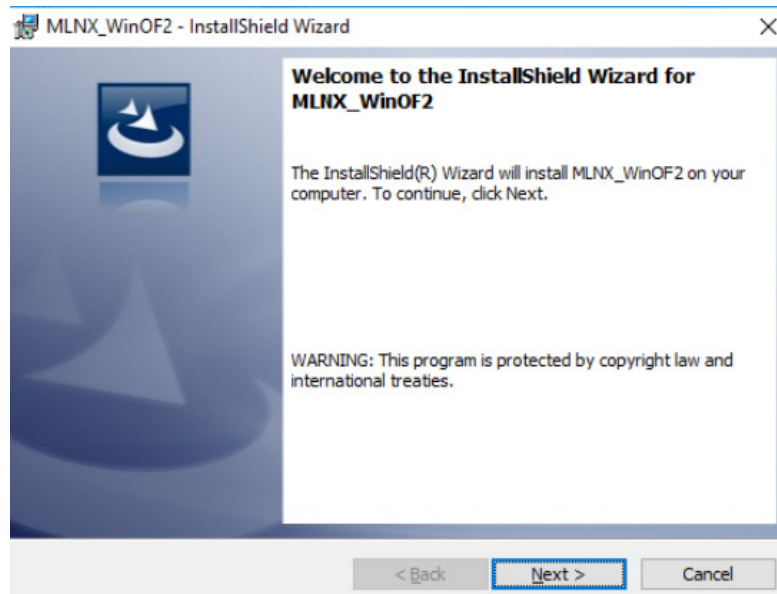
```
MLNX_WinOF2-1_10_<revision_version>_All_x64.exe /v"/l*vx [LogFile]"
```

Step 3. [Optional] If you do not want to upgrade your firmware version¹.

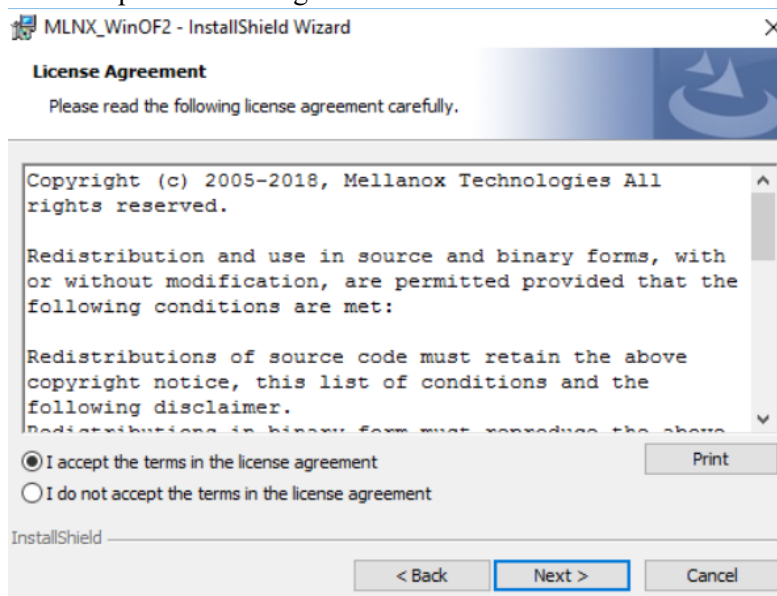
```
MLNX_WinOF2-1_10_<revision_version>_All_x64.exe /v" MT_SKIPFWUPGRD=1"
```

1. MT_SKIPFWUPGRD default value is False

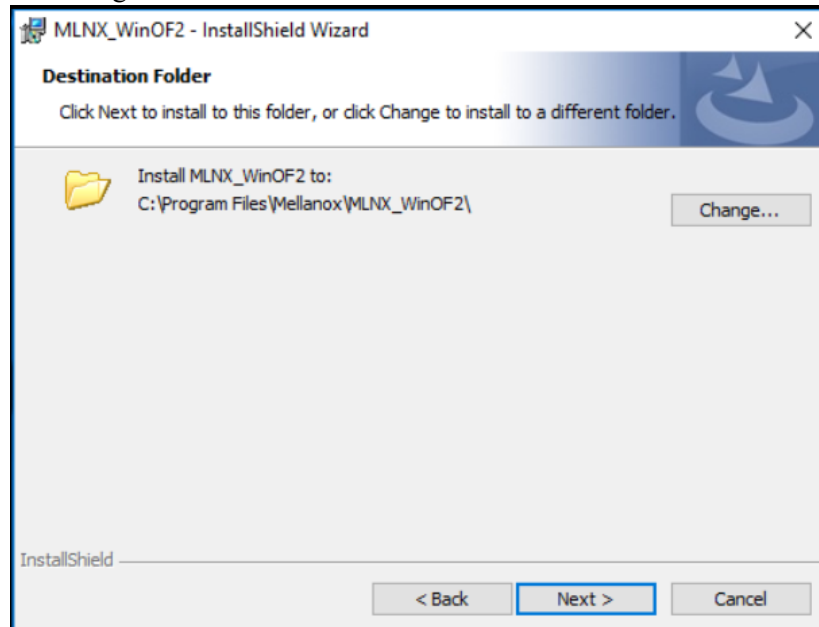
Step 4. Click Next in the Welcome screen.



Step 5. Read then accept the license agreement and click Next.

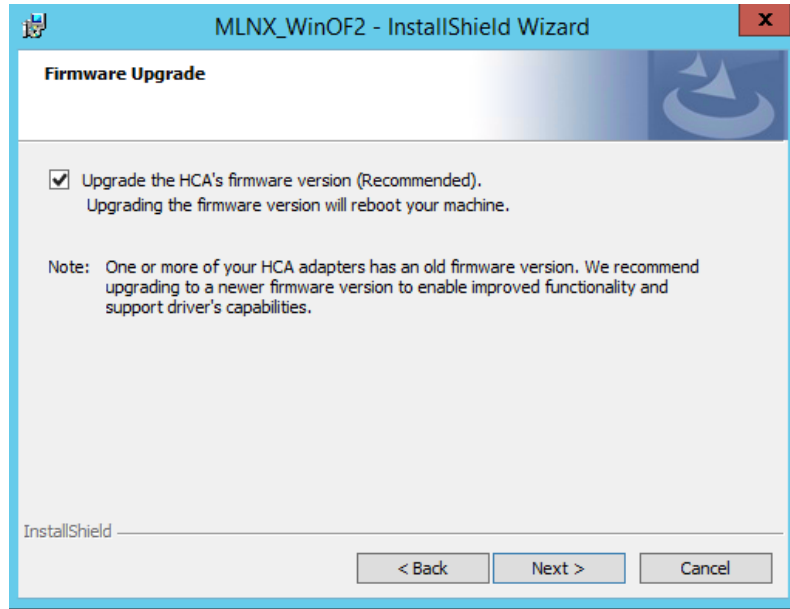


Step 6. Select the target folder for the installation.

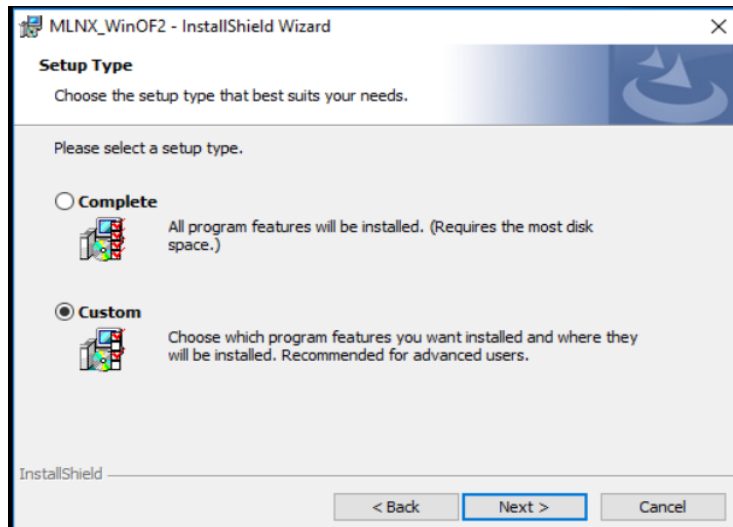


Step 7. The firmware upgrade screen will be displayed in the following cases:

- If the user has an OEM card. In this case, the firmware will not be displayed.
- If the user has a standard Mellanox card with an older firmware version, the firmware will be updated accordingly. However, if the user has both an OEM card and a Mellanox card, only the Mellanox card will be updated.



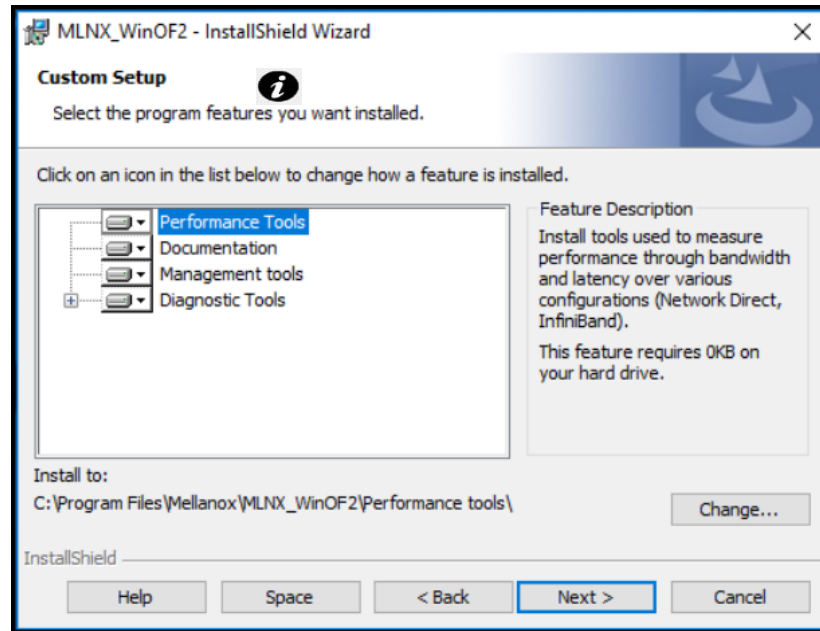
Step 8. Select a Complete or Custom installation, follow Step a and on.



a. Select the desired feature to install:

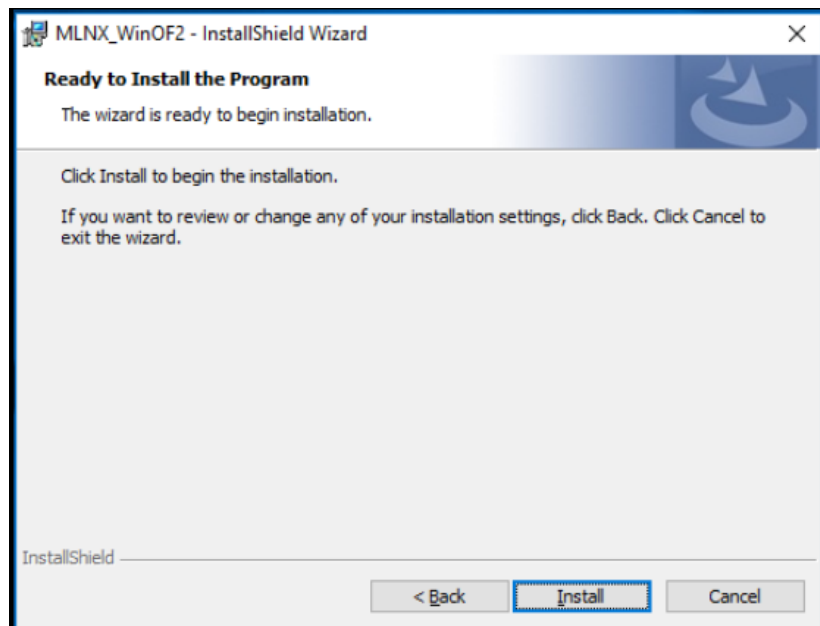
- Performances tools - install the performance tools that are used to measure performance in user environment
- Documentation - contains the User Manual and Release Notes
- Management tools - installation tools used for management, such as mlxstat


- Diagnostic Tools - installation tools used for diagnostics, such as mlx5cmd

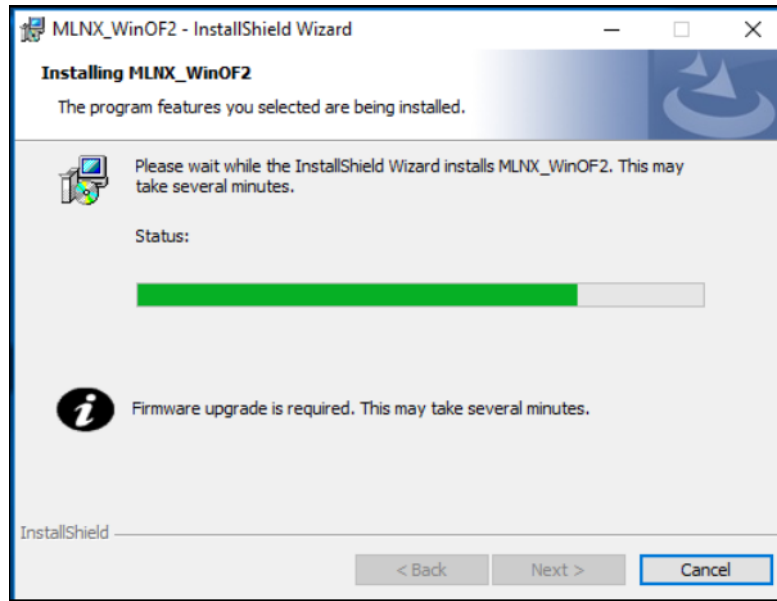


- b. Click Next to install the desired tools.

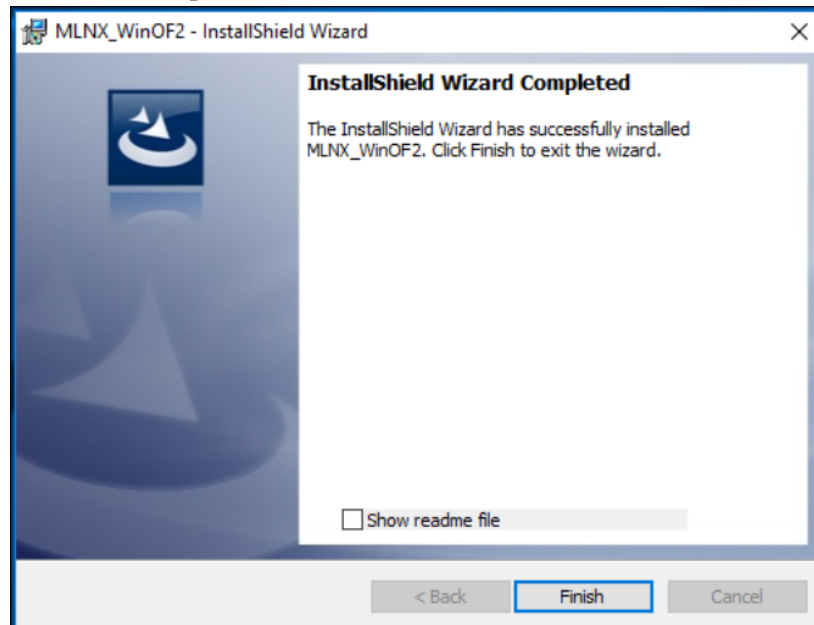
Step 9. Click Install to start the installation.



Step 10. In case that firmware upgrade option was checked in Step 7, you will be notified if a firmware upgrade is required (See ).



Step 11. Click Finish to complete the installation.



4.2.3.2 Unattended Installation



If no reboot options are specified, the installer restarts the computer whenever necessary without displaying any prompt or warning to the user.

Use the `/norestart` or `/forcerestart` standard command-line options to control reboots.

The following is an example of an unattended installation session.

Step 1. Open a CMD console-> Click Start-> Task Manager File-> Run new task-> and enter CMD.

Step 2. Install the driver. Run:

```
MLNX_WinOF2-1_10_<revision_version>_All_x64.exe /S /v/qn
```

Step 3. [Optional] Manually configure your setup to contain the logs option:

```
MLNX_WinOF2-1_10_All_x64.exe /S /v/qn /v"/l*vx [LogFile]"
```

Step 4. [Optional] if you want to control whether to install ND provider or not¹.

```
MLNX_WinOF2-1_10_All_x64.exe /vMT_NDPROPERTY=1
```

Step 5. [Optional] If you do not wish to upgrade your firmware version².

```
MLNX_WinOF2-1_10_All_x64.exe /vMT_SKIPFWUPGRD=1
```



Applications that hold the driver files (such as ND applications) will be closed during the unattended installation.

4.2.4 Installation Results

Upon installation completion, you can verify the successful addition of the network card(s) through the Device Manager.

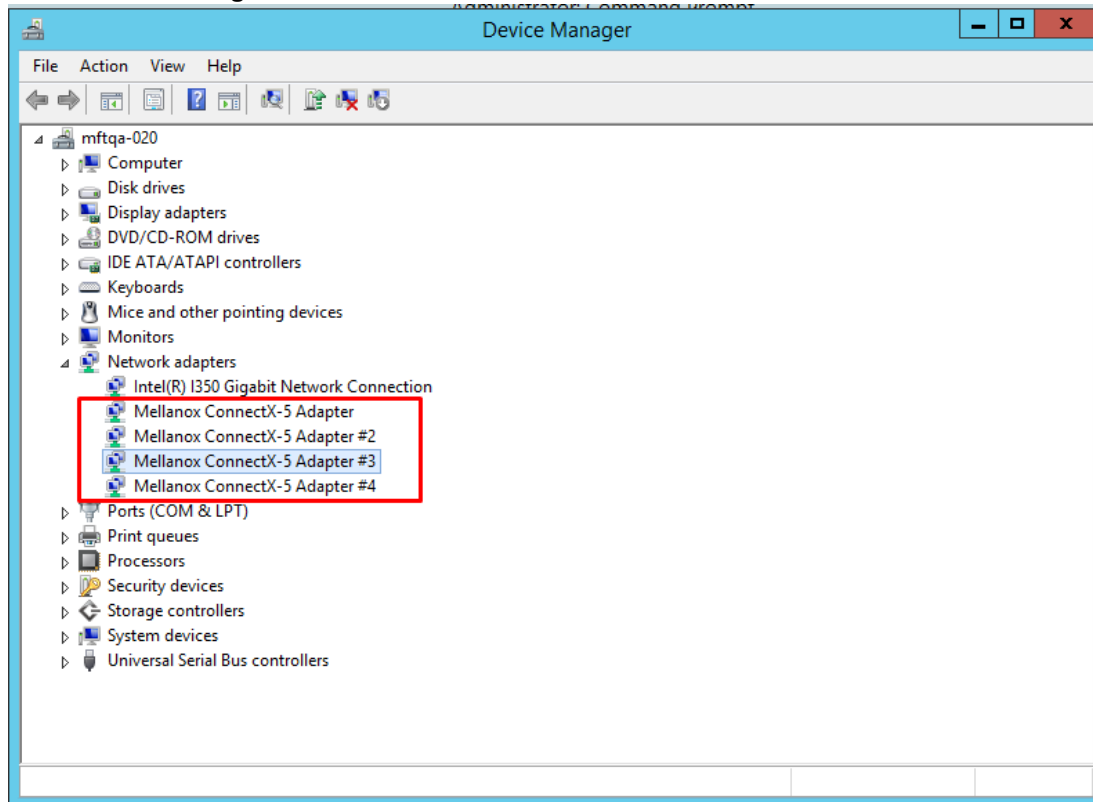
Upon installation completion, the inf files can be located at:

- %ProgramFiles%\Mellanox\MLNX_WinOF2\Drivers\<OS>

To see the Mellanox network adapters, display the Device Manager and pull down the “Network adapters” menu.

1. MT_NDPROPERTY default value is True
2. MT_SKIPFWUPGRD default value is False

Figure 2: ConnectX-5 Socket Direct Installation Results



The two PCIe cards are installed in two PCIe slots, each card gets a unique PCI Bus and Device number. Each of the PCIe x8 busses sees two network ports; in effect, the two 100Gb/s physical ports of the ConnectX-5 Socket Direct Adapter are viewed as four netdevices by the system

4.2.5 Extracting Files Without Running Installation

To extract the files without running installation, perform the following steps.

Step 1. Open a CMD console-> Click Start-> Task Manager-> File-> Run new task-> and enter CMD.

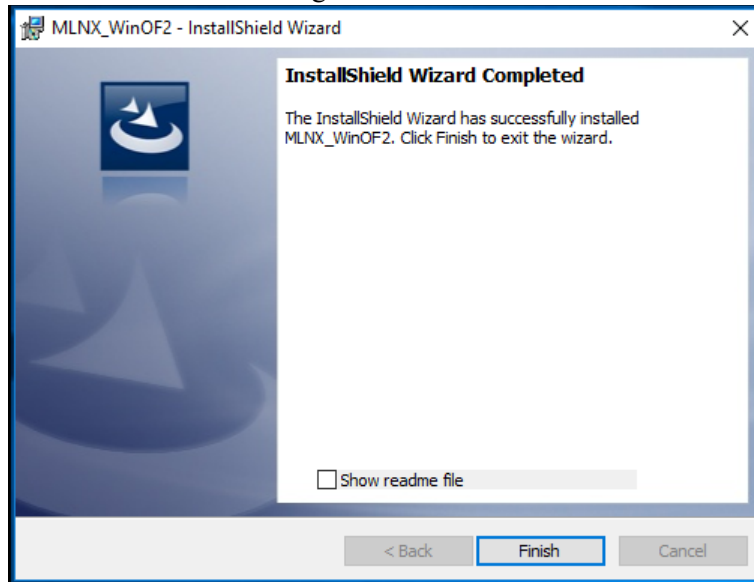
Step 2. Extract the driver and the tools:

```
MLNX_WinOF2-1_10_All_x64 /a
```

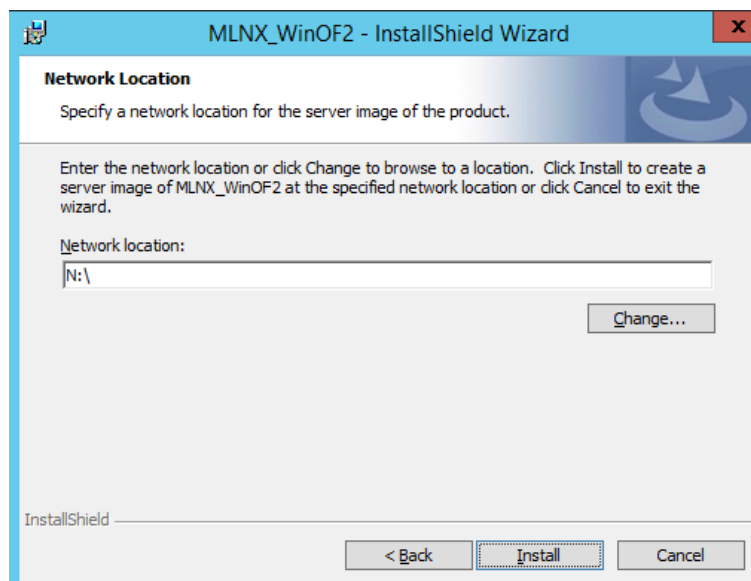
To extract only the driver files.

```
MLNX_WinOF2-1_10_All_x64 /a /vMT_DRIVERS_ONLY=1
```

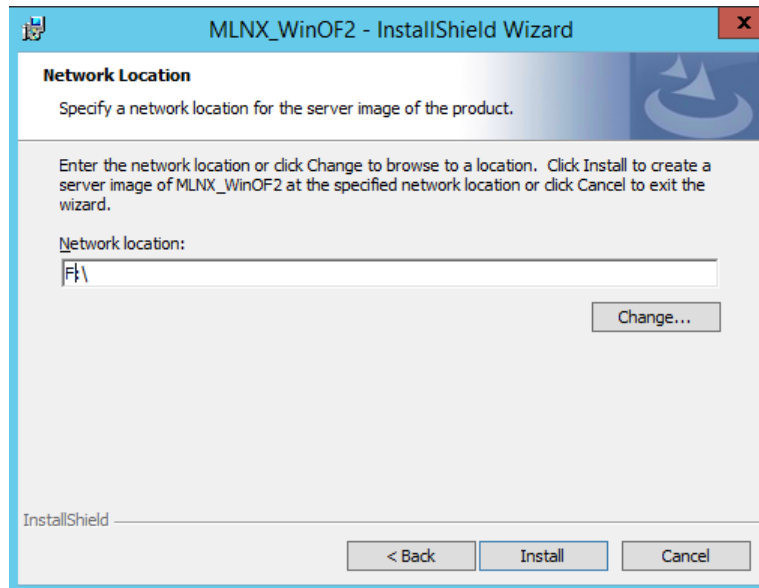
Step 3. Click Next to create a server image.



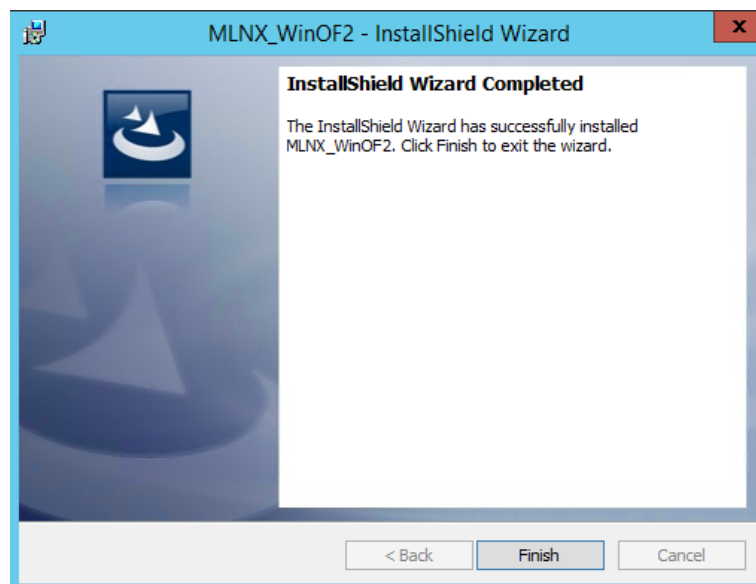
Step 4. Click Change and specify the location in which the files are extracted to.



Step 5. Click Install to extract this folder, or click Change to install to a different folder.



Step 6. To complete the extraction, click Finish.



4.2.6 Uninstalling Mellanox WinOF-2 Driver

4.2.6.1 Attended Uninstallation

➤ *To uninstall MLNX_WinOF2 on a single node:*

Click Start-> Control Panel-> Programs and Features-> MLNX_WinOF2-> Uninstall.
(NOTE: This requires elevated administrator privileges)

4.2.6.2 Unattended Uninstallation



If no reboot options are specified, the installer restarts the computer whenever necessary without displaying any prompt or warning to the user.

Use the `/norestart` or `/forcerestart` standard command-line options to control reboots.

➤ *To uninstall MLNX_WinOF2 in unattended mode:*

Step 1. Open a CMD console-> Click Start-> Task Manager-> File-> Run new task-> and enter CMD.

Step 2. Uninstall the driver. Run:

```
MLNX_WinOF2-1_10_All_x64.exe /S /x /v"/qn"
```

4.2.7 Firmware Upgrade

If the machine has a standard Mellanox card with an older firmware version, the firmware will be automatically updated as part of the WinOF-2 package installation.

For information on how to upgrade firmware manually, please refer to MFT User Manual:
www.mellanox.com => Products => Ethernet Drivers => Firmware Tools

4.2.8 Deploying the Driver on a Nano Server

4.2.8.1 Offline Installation

➤ *To deploy the Driver on a Nano Server:*

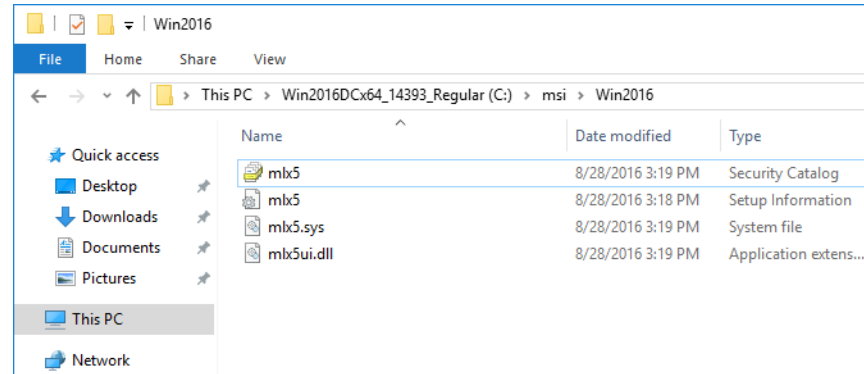
Step 1. Go to the Mellanox WinOF web page at <http://www.mellanox.com> => Products => InfiniBand/VPI Drivers => Windows SW/Drivers.

Step 2. Download the driver (MLNX_WinOF2_MLNX_WinOF2-1_64_mlx5_All_win2016_x64_fre_1_64_15407.exe).

Step 3. Extract the driver to a local directory (see [Section 4.2.5, “Extracting Files Without Running Installation”](#), on page 52).

Step 4. Copy the contents of this directory to C:\WS2016TP5_Drivers.

The directory contents should appear as follows:



This location should be specified for DriversPath property when injecting driver into the Nano server image:

```
New-NanoServerImage -MediaPath \\Path\To\Media\en_us -BasePath .\Base -TargetPath
.\InjectingDrivers.vhdx -DriversPath C:\WS2016TP5_Drivers
```

Step 5. Create the Nano server image.

Follow the instructions in the TechNet article for ["Getting Started with Nano Server"](#)

4.2.8.2 Online Update

- Step 1.** Go to the Mellanox WinOF web page at <http://www.mellanox.com> => Products => InfiniBand/VPI Drivers => Windows SW/Drivers.
- Step 2.** Download the driver package.
- Step 3.** Extract the Mellanox drivers to a local directory (see [Section 4.2.5, "Extracting Files Without Running Installation", on page 52](#)).
- Step 4.** Open a remote connection to the Nano server.
- Step 5.** Copy all the driver files to the Nano server
- Step 6.** Install the driver:

```
pnputil -I -a <Driver_Folder>\mlx5.inf
```



When upgrading the driver on a server where the remote connection was done over Mellanox device, there will be a loss of connectivity. To upgrade, it is recommended to run a script that will execute all the required upgrade commands.

5 Updating Adapter Card Firmware

Each card is shipped with the latest version of qualified firmware at the time of manufacturing. However, Mellanox issues firmware updates occasionally that provide new features and bug fixes. To check that your card is programmed with the latest available firmware version, download the `mlxup` firmware update and query utility. The utility can query for available Mellanox adapters and indicate which adapters require a firmware update. If the user confirms, `mlxup` upgrades the firmware using embedded images. The latest `mlxup` executable and documentation are available from <http://www.mellanox.com> => Products => Software => Firmware Tools.

5.1 Firmware Update Example

```
[server1]# ./mlxup
Querying Mellanox devices firmware ...

Device Type:      ConnectX-5
Part Number:     MCX556M-ECAT-S25
Description:     ConnectX®-5 VPI adapter card with Multi-Host Socket Direct supporting
dual-socket server, EDR IB (100Gb/s) and 100GbE, dual-port QSFP28, 2x PCIe3.0 x8, 25cm
harness, tall bracket, ROHS R6
PSID:           MT_2190110032
PCI Device Name: 0000:06:00.0
Base GUID:      e41d2d0300fd8b8a
Versions:       Current      Available
FW              16.00.0000    16.00.0000

Status:         Up to date

Device Type:      ConnectX-5
Part Number:     MCX556M-ECAT-S25
Description:     ConnectX®-5 VPI adapter card with Multi-Host Socket Direct supporting
dual-socket server, EDR IB (100Gb/s) and 100GbE, dual-port QSFP28, 2x PCIe3.0 x8, 25cm
harness, tall bracket, ROHS R6
PSID:           MT_2170110021
PCI Device Name: 0000:07:00.0
Base MAC:       0000e41d2da206d4
Versions:       Current      Available
FW              16.00.0000    16.00.0000

Status:         Update required

Perform FW update? [y/N]: y
Device #1: Up to date
Device #2: Updating FW ... Done

Restart needed for updates to take effect.
Log File: /var/log/mlxup/mlxup-yyyymmdd.log
```

6 Troubleshooting

6.1 General

Table 10 - General Troubleshooting

<p>Server unable to find the adapter</p>	<ul style="list-style-type: none"> • Ensure that the adapter is placed correctly • Make sure the adapter slot and the adapter are compatible • Install the adapter in a different PCI Express slot • Use the drivers that came with the adapter or download the latest • Make sure your motherboard has the latest BIOS • Try to reboot the server
<p>The adapter no longer works</p>	<ul style="list-style-type: none"> • Reseat the adapter 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 • Reboot the server
<p>Adapters stopped working after installing another adapter</p>	<ul style="list-style-type: none"> • Try removing and re-installing all adapters • Check that cables are connected properly • Make sure your motherboard has the latest BIOS
<p>Link indicator light is off</p>	<ul style="list-style-type: none"> • 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 adapter port are compatible
<p>Link light is on, but with no communication established</p>	<ul style="list-style-type: none"> • Check that the latest driver is loaded • Check that both the adapter and its link are set to the same speed and duplex settings

6.2 Linux

Table 11 - Linux Troubleshooting

Environment Information	<pre>cat /etc/issue uname -a cat /proc/cupinfo grep 'model name' uniq ofed_info -s ifconfig -a ip link show ethtool <interface> ethtool -i <interface_of_Mellanox_port_num> ibdev2netdev</pre>
Card Detection	<pre>lspci grep -i Mellanox</pre>
Mellanox Firmware Tool (MFT)	<p>Download and install MFT: http://www.mellanox.com/content/pages.php?pg=management_tools&menu_section=34 Refer to the User Manual for installation instructions.</p> <p>Once installed, run:</p> <pre>mst start mst status flint -d <mst_device> q</pre>
Ports Information	<pre>ibstat ibv_devinfo</pre>
Firmware Version Upgrade	<p>To download the latest firmware version refer to http://www.mellanox.com/supportdownloader</p>
Collect Log File	<pre>cat /var/log/messages dmesg >> system.log journalctl (Applicable on new operating systems) cat /var/log/syslog</pre>

6.3 Windows

Table 12 - Windows Troubleshooting

Environment Information	<p>From the Windows desktop choose the Start menu and run: msinfo32 To export system information to a text file, choose the Export option from the File menu. Assign a file name and save.</p>
Mellanox Firmware Tool (MFT)	<p>Download and install MFT: http://www.mellanox.com/content/pages.php?pg=management_tools&menu_section=34 Refer to the User Manual for installation instructions.</p> <p>Once installed, open a CMD window and run: WinMFT mst start mst status flint -d <mst_device> q</p>
Ports Information	<p>vstat</p>
Firmware Version Upgrade	<p>Download the latest firmware version using the PSID/board ID: http://www.mellanox.com/supportdownloader/ flint -d <mst_device> -i <firmware_bin_file> b</p>
Collect Log File	<ul style="list-style-type: none"> • Event log viewer • MST device logs: <ul style="list-style-type: none"> • mst start • mst status • flint -d <mst_device> dc > dump_configuration.log • mstdump <mst_device> dc > mstdump.log

7 .Specifications

7.1 MCX556M-ECAT-S25 Specifications

Table 13 - MCX556M-ECAT-S25 Specification Table

Physical	Low Profile Adapter Card Size: 6.6 in. x 2.71 in. (167.65mm x 68.90mm) Auxiliary PCIe Connection Card Size: 4.44 in. x 1.57 in. (113.0mm x 40.00mm) Slim-Line SAS Cable: 9.8 in. x 1.02 in. (250cm x 25.95mm)							
	Connector: Dual QSFP28 InfiniBand and Ethernet (copper and optical)							
Protocol Support	InfiniBand: IBTA v1.3 ^a Auto-Negotiation: 1X/2X/4X SDR (2.5Gb/s per lane), DDR (5Gb/s per lane), QDR (10Gb/s per lane), FDR10 (10.3125Gb/s per lane), FDR (14.0625Gb/s per lane), EDR (25Gb/s per lane) port							
	Ethernet: 100GBASE-CR4, 100GBASE-KR4, 100GBASE-SR4, 50GBASE-R2, 50GBASE-R4, 40GBASE-CR4, 40GBASE-KR4, 40GBASE-SR4, 40GBASE-LR4, 40GBASE-ER4, 40GBASE-R2, 25GBASE-R, 20GBASE-KR2, 10GBASE-LR, 10GBASE-ER, 10GBASE-CX4, 10GBASE-KX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR							
	Data Rate	<table border="1"> <tr> <td>InfiniBand</td> <td>SDR/DDR/QDR/FDR/EDR</td> </tr> <tr> <td>Ethernet</td> <td>1/10/25/40/50/100 Gb/s</td> </tr> </table>	InfiniBand	SDR/DDR/QDR/FDR/EDR	Ethernet	1/10/25/40/50/100 Gb/s		
	InfiniBand	SDR/DDR/QDR/FDR/EDR						
Ethernet	1/10/25/40/50/100 Gb/s							
PCI Express Gen3: SERDES @ 8.0GT/s, dual x8 lanes (2.0 and 1.1 compatible)								
Power and Environmental	Voltage: 12V							
	Power	Cable						
	Typical Power^b	<table border="1"> <tr> <td>Passive Cables</td> <td>17.1W</td> </tr> </table>	Passive Cables	17.1W				
	Passive Cables	17.1W						
	Maximum Power	<table border="1"> <tr> <td>Passive Cables</td> <td>20.0W</td> </tr> <tr> <td>1.5W Active Cables</td> <td>23.3W</td> </tr> <tr> <td>2.5W Active Cables</td> <td>25.5W</td> </tr> </table>	Passive Cables	20.0W	1.5W Active Cables	23.3W	2.5W Active Cables	25.5W
		Passive Cables	20.0W					
	1.5W Active Cables	23.3W						
	2.5W Active Cables	25.5W						
Maximum power available through QSFP28 port: 5W								
Temperature	Operational	0°C to 55°C						
	Non-operational	-40°C to 70°C						
Humidity: 90% relative humidity ^c								
Air Flow: See Airflow Specifications on page 71								
Regulatory	Safety: CB / cTUVus / CE							
	EMC: CE / FCC / VCCI / ICES / RCM							
	RoHS: RoHS-R6							

- a. The ConnectX-5 adapters supplement the IBTA auto-negotiation specification to get better bit error rates and longer cable reaches. This supplemental feature only initiates when connected to another Mellanox Infini-Band product.
- b. Typical power for ATIS traffic load.
- c. For both operational and non-operational states.

7.2 Airflow Specifications

Table 14 - Airflow Specifications

Air Flow (LFM)					
Air Flow Direction - Heat Sink to Port					
Cable Type	Passive	Active 1.5W	Active 2.5W	Active 3.5W	Active 5W
MCX556M-ECAT-S25	400	400	500	600	900

7.3 Adapter Card LED Operations

There is one bi-color I/O LED per port to indicate link status. See [Table 15](#).

Table 15 - Physical and Logical Link Indications (Ethernet Mode)

LED Color and State	Description
Off	A link has not been established
Blinking Amber ^a	6 Hz blinking Amber indicates a problem with the link
Solid Green	Indicates a valid link with no active traffic
Blinking Green	Indicates a valid logical link with active traffic

a. 1 Hz Blinking Amber occurs due to running a beacon command for locating the adapter card.

Table 16 - Physical and Logical Link Indications (InfiniBand Mode)

LED Color and State	Description
Off	Physical link has not been established
Solid Amber	Indicates an active physical link
Blinking Amber ^a	6 Hz blinking Amber indicates a problem with the physical link
Solid Green	Indicates a valid logical (data activity) link with no active traffic
Blinking Green	Indicates a valid logical link with active traffic

a. 1 Hz Blinking Amber occurs due to running a beacon command for locating the adapter card.

7.4 Board Mechanical Drawing and Dimensions



All dimensions are in millimeters.
All the mechanical tolerances are +/- 0.1mm.



Fore the 3D Model of the card, please refer to [3D Models](#).

Figure 3: Mechanical Drawing of the Dual-port Adapter Card

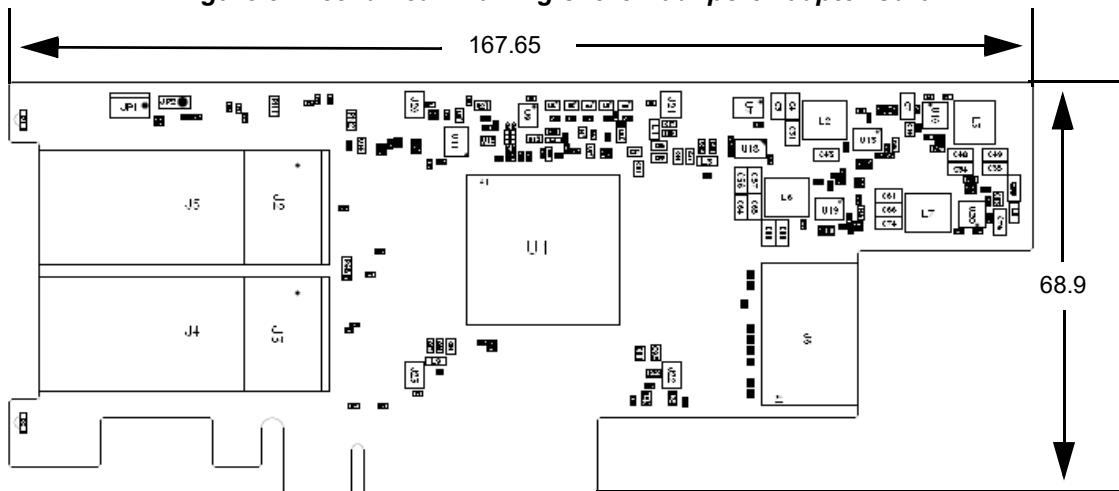


Figure 4: Mechanical Drawing of the Auxiliary PCIe Connection Card

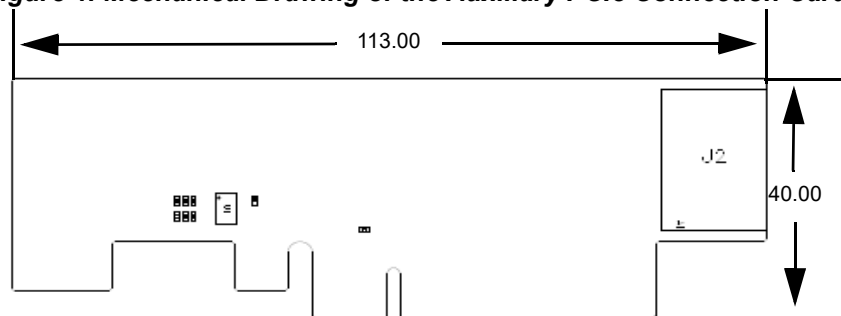
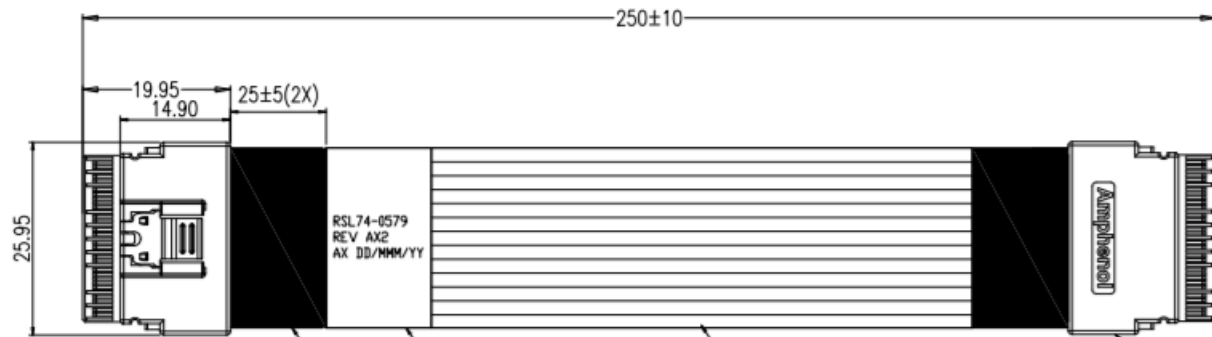


Figure 5: Mechanical Drawing of the Slim-Line SAS Cable



7.5 Bracket Mechanical Drawing

Figure 6: Adapter Card Tall Bracket

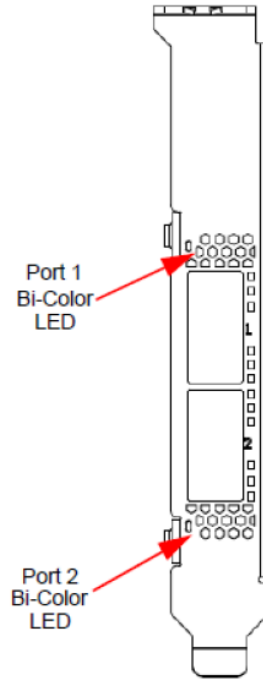
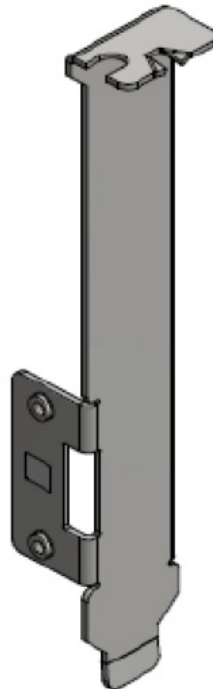


Figure 7: Auxiliary PCIe Connection Card Tall Bracket



Appendix A: Interface Connectors Pinout

A.1 QSFP28 Connector Pinout

Figure 8: Connector and Cage Views

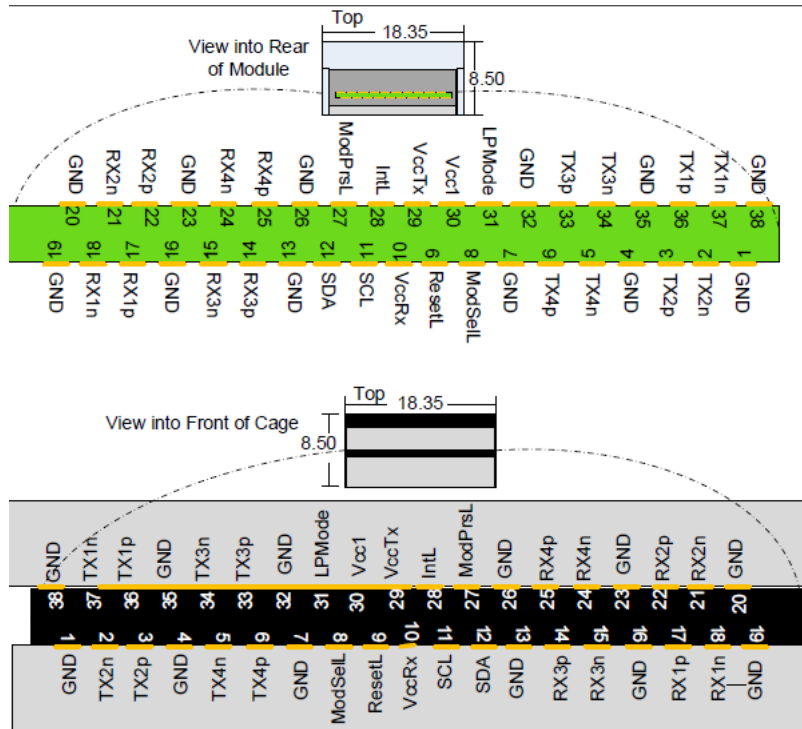


Table 17 - Connector Pin Number and Name to Signal Name Map

Pin	Symbol Name	Description
1	GND	Ground
2	Tx2n	Transmitter Inverted Data Input
3	Tx2p	Transmitter Non-Inverted Data Input
4	GND	Ground
5	Tx4n	Transmitter Inverted Data Input
6	Tx4p	Transmitter Non-Inverted Data Input
7	GND	Ground
8	ModSelL	Module Select
9	ResetL	Module Reset
10	Vcc Rx	+3.3 V Power supply receiver
11	SCL	2-wire serial interface clock
12	SDA	2-wire serial interface data
13	GND	Ground
14	Rx3p	Receiver Non-Inverted Data Output
15	Rx3n	Receiver Inverted Data Output

16	GND	Ground
17	Rx1p	Receiver Non-Inverted Data Output
18	Rx1n	Receiver Inverted Data Output
19	GND	Ground
20	GND	Receiver Non-Inverted Data Output
21	Rx1n	Receiver Inverted Data Output
22	Rx1p	Ground
23	GND	Ground
24	Rx2n	Receiver Inverted Data Output
25	Rx2p	Receiver Non-Inverted Data Output
26	GND	Ground
27	Mod PrsL	Module Present
28	IntL	Interrupt
29	VccTx	+3.3 V Power supply transmitter
30	Vcc1	+3.3 V Power Supply
31	LPMode	Low Power Mode
32	GND	Ground
33	Tx3p	Receiver Inverted Data Output
34	Tx3n	Receiver Non-Inverted Data Output
35	GND	Ground
36	Tx1p	Receiver Inverted Data Output
37	Tx1n	Receiver Non-Inverted Data Output
38	GND	Ground

A.2 PCI Express x16 Connector Pinout

The adapter cards support PCI Express 3.0 two PCIe x8 connectors; a standard PCI Express x8 edge connector and Slim-Line SAS connector pinout according to SFF/9401 standards. PCIe x16 Connector Pinout.

Figure 9: PCIe x8 Edge Connector Pinout

A1	PRST1#	+12V-1	B1
A2	+12V-5	+12V-2	B2
A3	+12V-4	+12V-3	B3
A4	GND-28	GND-29	B4
A5	TCK	SMCLK	B5
A6	TDI	SMDAT	B6
A7	TDO	GND-11	B7
A8	TMS	+3.3V-3	B8
A9	+3.3V-1	TRST#	B9
A10	+3.3V-2	3.3Vaux	B10
A11	PERST#	WAKE#/OBFF	B11
A12	GND-22	RSVD-5	B12
A13	REFCLK+	GND-4	B13
A14	REFCLK-	PETp0	B14
A15	GND-21	PETn0	B15
A16	PERp0	GND-7	B16
A17	PERn0	B17-NC-PRST2-1	B17
A18	GND-19	GND-9	B18
A19	RSVD-4	PETp1	B19
A20	GND-18	PETn1	B20
A21	PERp1	GND-32	B21
A22	PERn1	GND-13	B22
A23	GND-15	PETp2	B23
A24	GND-14	PETn2	B24
A25	PERp2	GND-16	B25
A26	PERn2	GND-17	B26
A27	GND-24	PETp3	B27
A28	GND-10	PETn3	B28
A29	PERp3	GND-20	B29
A30	PERn3	RSVD-2	B30
A31	GND-8	B31-NC-PRST2-1	B31
A32	RSVD-3	GND-23	B32
A33	RSVD-1	PETp4	B33
A34	GND-6	PETn4	B34
A35	PERp4	GND-26	B35
A36	PERn4	GND-27	B36
A37	GND-5	PETp5	B37
A38	GND-3	PETn5	B38
A39	PERp5	GND-30	B39
A40	PERn5	GND-31	B40
A41	GND-2	PETp6	B41
A42	GND-1	PETn6	B42
A43	PERp6	GND-34	B43
A44	PERn6	GND-35	B44
A45	GND-25	PETp7	B45
A46	GND-12	PETn7	B46
A47	PERp7	GND-37	B47
A48	PERn7	PRST2#-3	B48
A49	GND-33	GND-36	B49



Applies to both to the adapter card and the auxiliary PCIe connection card.

Table 18 - Slim-Line SAS Pinout Connector on the Adapter Card

Connector Pin #	Connector Pin Name
A1	GND
A2	PCIE_CPU_CX_1AP
A3	PCIE_CPU_CX_1AN
A4	GND
A5	PCIE_CPU_CX_1BP
A6	PCIE_CPU_CX_1BN
A7	GND
A8	I2C_SMCLK_H1
A9	I2C_SMDAT_H1
A10	GND
A11	S_PERST1_CONN_L
A12	S_PRSENT1_L
A13	GND
A14	PCIE_CPU_CX_1CP
A15	PCIE_CPU_CX_1CN
A16	GND
A17	PCIE_CPU_CX_1D
A18	PCIE_CPU_CX_1DN
A19	GND
A20	PCIE_CPU_CX_1EP
A21	PCIE_CPU_CX_1EN
A22	GND
A23	PCIE_CPU_CX_1FP
A24	PCIE_CPU_CX_1FN
A25	GND
A26	NC
A27	NC
A28	GND
A29	NC
A30	S_PRSENT1_R_L
A31	GND
A32	PCIE_CPU_CX_1GP
A33	PCIE_CPU_CX_1GN
A34	GND
A35	PCIE_CPU_CX_1HP

Table 18 - Slim-Line SAS Pinout Connector on the Adapter Card

Connector Pin #	Connector Pin Name
A36	PCIE_CPU_CX_1HN
A37	GND
B1	GND
B2	PCIE_CX_CPU_1AP
B3	PCIE_CX_CPU_1AN
B4	GND
B5	PCIE_CX_CPU_1BP
B6	PCIE_CX_CPU_1BN
B7	GND
B8	NC
B9	S_WAKE1_CONN_L
B10	GND
B11	PCIE_REFCLK1_P
B12	PCEI_REFCLK1_N
B13	GND
B14	PCIE_CX_CPU_1CP
B15	PCIE_CX_CPU_1CN
B16	GND
B17	PCIE_CX_CPU_1DP
B18	PCIE_CX_CPU_1DN
B19	GND
B20	PCIE_CX_CPU_1EP
B21	PCIE_CX_CPU_1EN
B22	GND
B23	PCIE_CX_CPU_1FP
B24	PCIE_CX_CPU_1FN
B25	GND
B26	NC
B27	NC
B28	GND
B29	NC
B30	NC
B31	GND
B32	PCIE_CX_CPU_1GP
B33	PCIE_CX_CPU_1GN
B34	GND

Table 18 - Slim-Line SAS Pinout Connector on the Adapter Card

Connector Pin #	Connector Pin Name
B35	PCIE_CX_CPU_1HP
B36	PCIE_CX_CPU_1HN
B37	GND
SH1	GND
SH2	GND
SH3	GND
SH4	GND

Table 19 - Slim-Line SAS Pinout Connector on the Auxiliary PCIe Connection Card

Connector Pin #	Connector Pin Name
A1	GND
A2	PCIE_CX_CPU_1AP
A3	PCIE_CX_CPU_1AN
A4	GND
A5	PCIE_CX_CPU_1BP
A6	PCIE_CX_CPU_1BN
A7	GND
A8	NC
A9	S_WAKE1_CONN_L
A10	GND
A11	PCIE_REFCLK1_P
A12	PCEI_REFCLK1_N
A13	GND
A14	PCIE_CX_CPU_1CP
A15	PCIE_CX_CPU_1CN
A16	GND
A17	PCIE_CX_CPU_1DP
A18	PCIE_CX_CPU_1DN
A19	GND
A20	PCIE_CX_CPU_1EP
A21	PCIE_CX_CPU_1EN
A22	GND
A23	PCIE_CX_CPU_1FP
A24	PCIE_CX_CPU_1FN
A25	GND
A26	NC

Table 19 - Slim-Line SAS Pinout Connector on the Auxiliary PCIe Connection Card

Connector Pin #	Connector Pin Name
A27	NC
A28	GND
A29	NC
A30	NC
A31	GND
A32	PCIE_CX_CPU_1GP
A33	PCIE_CX_CPU_1GN
A34	GND
A35	PCIE_CX_CPU_1HP
A36	PCIE_CX_CPU_1HN
A37	GND
B1	GND
B2	PCIE_CPU_CX_1AP
B3	PCIE_CPU_CX_1AN
B4	GND
B5	PCIE_CPU_CX_1BP
B6	PCIE_CPU_CX_1BN
B7	GND
B8	I2C_SMCLK_H1
B9	I2C_SMDAT_H1
B10	GND
B11	S_PERST1_CONN_L
B12	S_PRSNT1_L
B13	GND
B14	PCIE_CPU_CX_1CP
B15	PCIE_CPU_CX_1CN
B16	GND
B17	PCIE_CPU_CX_1D
B18	PCIE_CPU_CX_1DN
B19	GND
B20	PCIE_CPU_CX_1EP
B21	PCIE_CPU_CX_1EN
B22	GND
B23	PCIE_CPU_CX_1FP
B24	PCIE_CPU_CX_1FN
B25	GND

Table 19 - Slim-Line SAS Pinout Connector on the Auxiliary PCIe Connection Card

Connector Pin #	Connector Pin Name
B26	NC
B27	NC
B28	GND
B29	NC
B30	S_PRSNT1_R_L
B31	GND
B32	PCIE_CPU_CX_1GP
B33	PCIE_CPU_CX_1GN
B34	GND
B35	PCIE_CPU_CX_1HP
B36	PCIE_CPU_CX_1HN
B37	GND
SH1	GND
SH2	GND
SH3	GND
SH4	GND

Appendix B: Finding the GUID/MAC and Serial Number on the Adapter Card

Each Mellanox adapter card has a different identifier printed on the label: serial number and the card MAC for the Ethernet protocol and the card GUID for the InfiniBand protocol. VPI cards have both a GUID and a MAC (derived from the GUID)..



The revision indicated on the labels in the following figures do not necessarily represent the latest revision of the card.

Figure 10: MCX556M-ECAT-S25 Board Label (Example)



Figure 11: Auxiliary PCIe Connection Card Board Label



Figure 12: Slim-Line SAS Harness Board Label



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Appendix C: Safety Warnings

1. Installation Instructions



Read all installation instructions before connecting the equipment to the power source.

2. Over-temperature



This equipment should not be operated in an area with an ambient temperature exceeding the maximum recommended: 55°C (131°F).

To guarantee proper air flow, allow at least 8cm (3 inches) of clearance around the ventilation openings.

3. During Lightning - Electrical Hazard



During periods of lightning activity, do not work on the equipment or connect or disconnect cables.

4. Copper Cable Connecting/Disconnecting



Some copper cables are heavy and not flexible, as such they should be carefully attached to or detached from the connectors. Refer to the cable manufacturer for special warnings and instructions.

5. Equipment Installation



This equipment should be installed, replaced, or serviced only by trained and qualified personnel.

6. Equipment Disposal



Disposal of this equipment should be in accordance to all national laws and regulations.

7. Local and National Electrical Codes



This equipment should be installed in compliance with local and national electrical codes.

8. Hazardous Radiation Exposure



Caution – Use of controls or adjustment or performance of procedures other than those specified herein may result in hazardous radiation exposure.



CLASS 1 LASER PRODUCT and reference to the most recent laser standards: IEC 60 825-1:1993 + A1:1997 + A2:2001 and EN 60825-1:1994+A1:1996+A2:20.

Appendix D: Avertissements de sécurité d'installation (Warnings in French)

1. Instructions d'installation



Lisez toutes les instructions d'installation avant de brancher le matériel à la source d'alimentation électrique.

2. Température excessive



Ce matériel ne doit pas fonctionner dans une zone avec une température ambiante dépassant le maximum recommandé de 55°C (131°F). Un flux d'air de 200LFM à cette température ambiante maximale est nécessaire. En outre, pour garantir un bon écoulement de l'air, laissez au moins 8 cm (3 pouces) d'espace libre autour des ouvertures de ventilation.

3. Orages – dangers électriques



Pendant un orage, il ne faut pas utiliser le matériel et il ne faut pas brancher ou débrancher les câbles.

4. Branchement/débranchement des câbles en cuivre



Les câbles en cuivre sont lourds et ne sont pas flexibles, il faut donc faire très attention en les branchant et en les débranchant des connecteurs. Consultez le fabricant des câbles pour connaître les mises en garde et les instructions spéciales.

5. Installation du matériel



Ce matériel ne doit être installé, remplacé ou entretenu que par du personnel formé et qualifié.

6. Elimination du matériel



L'élimination de ce matériel doit s'effectuer dans le respect de toutes les législations et réglementations nationales en vigueur.

7. Codes électriques locaux et nationaux



Ce matériel doit être installé dans le respect des codes électriques locaux et nationaux.

8. Exposition au rayonnement grave



Mise en garde – l'utilisation de commandes ou de réglages ou l'exécution de procédures autres que ce qui est spécifié dans les présentes peut engendrer une exposition au rayonnement grave.



PRODUIT LASER DE CLASSE 1 » et références aux normes laser les plus récentes CEI 60 825-1

Appendix E: Sicherheitshinweise (Warnings in German)

1. Installationsanleitungen



Lesen Sie alle Installationsanleitungen, bevor Sie das Gerät an die Stromversorgung anschließen.

2. Übertemperatur



Dieses Gerät sollte nicht in einem Bereich mit einer Umgebungstemperatur über der maximal empfohlenen Temperatur von 55°C (131°F) betrieben werden. Es ist ein Luftstrom von 200 LFM bei maximaler Umgebungstemperatur erforderlich. Außerdem sollten mindestens 8 cm (3 in.) Freiraum um die Belüftungsöffnungen sein, um einen einwandfreien Luftstrom zu gewährleisten.

3. Bei Gewitter - Elektrische Gefahr



Arbeiten Sie während eines Gewitters und Blitzschlag nicht am Gerät, schließen Sie keine Kabel an oder ab.

4. Anschließen/Trennen von -Kupferkabel



Kupferkabel sind schwer und nicht flexible. Deshalb müssen sie vorsichtig an die Anschlüsse angebracht bzw. davon getrennt werden. Lesen Sie die speziellen Warnungen und Anleitungen des Kabelherstellers.

5. Geräteinstallation



Diese Gerät sollte nur von geschultem und qualifiziertem Personal installiert, ausgetauscht oder gewartet werden.

6. Geräteentsorgung



Die Entsorgung dieses Geräts sollte unter Beachtung aller nationalen Gesetze Bestimmungen erfolgen.

7. Regionale und nationale elektrische Bestimmungen t



Dieses Gerät sollte unter Beachtung der regionalen und nationalen elektrischen Bestimmungen installiert werden.

8. Strahlenkontakt



Achtung – Nutzung von Steuerungen oder Einstellungen oder Ausführung von Prozeduren, die hier nicht spezifiziert sind, kann zu gefährlichem Strahlenkontakt führen.



Klasse 1 Laserprodukt und Referenzen zu den aktuellsten Lasterstandards :
ICE 60 825-1

Appendix F: Advertencias de seguridad para la instalación (Warnings in Spanish)

1. Instrucciones de instalación



Antes de conectar el equipo a la fuente de alimentación, leer todas las instrucciones de instalación.

2. Sobre calentamiento



No se debe utilizar el equipo en un área con una temperatura ambiente superior a la máxima recomendada: 55°C(131°F). Además, para garantizar una circulación de aire adecuada, se debe dejar como mínimo un espacio de 8 cm (3 pulgadas) alrededor de las aberturas de ventilación.

3. Cuando hay rayos: peligro de descarga eléctrica



No utilizar el equipo ni conectar o desconectar cables durante períodos de actividad de rayos.

4. Conexión y desconexión del cable Copper



Dado que los cables de cobre son pesados y no son flexibles, su conexión a los conectores y su desconexión se deben efectuar con mucho cuidado. Para ver advertencias o instrucciones especiales, consultar al fabricante del cable.

5. Instalación de equipos



La instalación, el reemplazo y el mantenimiento de este equipo estarán a cargo únicamente de personal capacitado y competente.

6. Eliminación de equipos



La eliminación definitiva de este equipo se debe efectuar conforme a todas las leyes y reglamentaciones nacionales.

7. Códigos eléctricos locales y nacionales



Este equipo se debe instalar conforme a los códigos eléctricos locales y nacionales.

8. Exposición a niveles de radiación peligrosos



Precaución: el uso de controles o ajustes o la realización de procedimientos distintos de los que aquí se especifican podrían causar exposición a niveles de radiación peligrosos.



PRODUCTO LÁSER DE CLASE 1 y referencia a las normas de láser más recientes:
IEC 60825-1