Mellanox ConnectX®-5 and ConnectX®-5 VPI Adapter Cards User Manual

P/N:

MCX555A-ECAT, MCX556A-ECAT, MCX556A-EDAT

Rev 1.5

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Revision History

This document was printed on November 1, 2018.

Table 1 - Revision History Table

Date	Rev	Comments/Changes
July 2018	1.5	• Updated Adapter Card LED Operations on page 55
January 2018	1.4	• Updated Adapter Card LED Operations on page 55 • Added a note to Hardware on page 10
November 2017	1.3	• Updated Adapter Card LED Operations on page 55

October 2017	1.2	• Updated the following specification tables:
		  • MCX555A-ECAT Specification Table on page 52
		  • MCX556A-ECAT Specification Table on page 53
		  • MCX556A-EDAT Specification Table on page 57
		• Updated Linux on page 19

April 2017	1.1	• Updated Product Overview on page 5 • Updated Card Installation Instructions on page 12
March 2017	1.0	First release

About This Manual

This *User Manual* describes Mellanox Technologies ConnectX®-5 and ConnectX®-5 Ex Single and Dual QSFP28 port PCI Express x16 adapter cards It provides details as to the interfaces of the board, specifications, required software and firmware for operating the board, 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

Mellanox Firmware Tools (MFT) User Manual Document no. 2204UG	User Manual describing the set of MFT firmware management tools for a single node. See http://www.mellanox.com => Products => Software => Firmware Tools
Mellanox Firmware Utility (mlxup) User Manual and Release Notes	Mellanox firmware update and query utility used to update the firmware. See http://www.mellanox.com => Products => Software => Firmware Tools => mlxup Firmware Utility
Mellanox OFED for Linux User Manual Document no. 2877	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)
Mellanox OFED for Linux Release Notes Document no. 2877	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
WinOF-2 for Windows User Manual Document no. MLX-15-3280	User Manual describing WinOF-2 features, performance, Ethernet diagnostic, tools content and configuration. See http://www.mellanox.com => Products => Software => Windows SW/Drivers
Mellanox OFED for Windows Driver Release Notes	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
IBTA Specification Release 1.3	InfiniBand Architecture Specification: http://www.infinibandta.org/content/pages.php?pg=technology_public_specification

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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- URL: http://www.mellanox.com => Support
- E-mail: support@mellanox.com
- Tel: +1.408.916.0055

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http://www.mellanox.com => Support

Or use the following link to go directly to the Mellanox Support Download Assistant page,

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 for Open Compute Project. These adapters connectivity provide the highest performing and most flexible interconnect solution for PCI Express Gen 3.0/4.0servers used in Enterprise Data Centers and High-Performance Computing environments.

This chapter covers the following topics:

1.1 Product Overview

The following section provides the ordering part number, port speed, number of ports, and PCI Express speed.Each adapter comes with two bracket heights - short and tall.

Table 3 - Single and Dual-port VPI Adapter Cards

Ordering Part Number (OPN)	Single-port card: MCX555A-ECAT Dual-port cards: MCX556A-ECAT, MCX556A-EDAT
Data Transmission Rate	InfiniBand: SDR/DDR/QDR/FDR/EDR Ethernet: 1/10/25/40/50/100 Gb/s
Network Connector Types	Single and dual-port QSFP28
PCI Express (PCIe) SerDes Speed	**MCX555A-ECAT, MCX556A-ECAT:** PCIe 3.0 x16 8GT/s Note: PCIe 3.0 x16 bus can supply a maximum bandwidth of 128Gb/s only (=16 * 8GT/s, including overhead), and therefore cannot support 200Gb/s when both network ports of MCX556A-ECAT run at 100Gb/s. **MCX556A-EDAT:** PCIe 4.0 x16 16GT/s *Note: This card has been tested and certified with PCIe 3.0 servers. PCIe 4.0 interface will be tested when servers with Gen 4.0 support become available.* *Note: PCIe 4.0 x16 bus can supply a maximum bandwidth of 256Gb/s (=16 * 16GT/s, including overhead), and can support 200Gb/s when both network ports of MCX556A-EDAT run at 100Gb/s.*
RoHS	R6
Adapter IC Part Number	**MCX555A-ECAT, MCX556A-ECAT:** MT27808A0-FCCF-EV **MCX556A-EDAT:** MT28808A0-FCCF-EV
Device ID (decimal)	**MCX555A-ECAT, MCX556A-ECAT:** 4119 for Physical Function (PF) and 4120 for Virtual Function (VF) **MCX556A-EDAT:** 4121 for Physical Function (PF) and 4122 for Virtual Function (VF)

1.2   Features and Benefits

Table 4 - Features[a]

100Gb/s Virtual Protocol Interconnect (VPI) Adapter	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.
InfiniBand Architecture Specification v1.3 compliant	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.
PCI Express (PCIe)	Uses PCIe Gen 3.0 (8GT/s) and Gen 4.0 (16GT/s) through an x16 edge connector. Gen 1.1 and 2.0 compatible.
Up to 100 Gigabit Ethernet	Mellanox adapters comply with the following IEEE 802.3 standards: – 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)
InfiniBand EDR	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.
Memory	PCI Express - stores and accesses InfiniBand and/or Ethernet fabric connection information and packet data.SPI Quad - includes 128Mbit SPI Quad Flash device (W25Q128FVSIG device by ST Microelectronics) VPD EEPROM - The EEPROM capacity is 128Kbit.
Overlay Networks	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.
RDMA and RDMA over Converged Ethernet (RoCE)	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.

Table 4 - Features[a]

Mellanox PeerDirect™	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.
CPU Offload	Adapter functionality enabling reduced CPU overhead allowing more available CPU for computation tasks. Open VSwitch (OVS) offload using ASAP$^{2(TM)}$ • Flexible match-action flow tables • Tunneling encapsulation / decapsulation
Quality of Service (QoS)	Support for port-based Quality of Service enabling various application requirements for latency and SLA.
Hardware-based I/O Virtualization	ConnectX-5 provides dedicated adapter resources and guaranteed isolation and protection for virtual machines within the server.
Storage Acceleration	A consolidated compute and storage network achieves significant cost-performance advantages over multi-fabric networks. Standard block and file access protocols can leverage InfiniBand RDMA for high-performance storage access. • NVMe over Fabric offloads for target machine • Erasure Coding • T10-DIF Signature Handover
SR-IOV	ConnectX-5 SR-IOV technology provides dedicated adapter resources and guaranteed isolation and protection for virtual machines (VM) within the server.
High-Performance Accelerations	• 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" on page 3..

1.3   Operating Systems/Distributions

- RHEL/CentOS

- Windows

- FreeBSD

- VMware

- OpenFabrics Enterprise Distribution (OFED)

- OpenFabrics Windows Distribution (WinOF-2)

1.4   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

2 Interfaces

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

Each adapter card includes the following interfaces:

- "InfiniBand Interface"
- "Ethernet QSFP28 Interface"
- "PCI Express Interface"
- "LED Interface"

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 QSFP28 Interface

The network ports of the ConnectX®-5 adapter card are compliant with the IEEE 802.3 Ethernet standards listed in Table 4. Ethernet traffic is transmitted through the cards' QSFP28 connectors.

2.3 PCI Express Interface

The ConnectX®-5 adapter card supports PCI Express Gen 3.0/4.0 (1.1 and 2.0 compatible) through an x16 edge connector.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 and 4.0 compliant, 2.0 and 1.1 compatible
- 2.5, 5.0, 8.0, or 16.0GT/slink rate x16
- Auto-negotiates to x16, x8, x4, x2, or x1
- 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 7.5, "Adapter Card LED Operations", on page 55.

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 a PCI Express x16 slot is required for installing the card.

3.1.2 Operating Systems/Distributions

Please refer to Section 1.3, "Operating Systems/Distributions", on page 7.

3.1.3 Software Stacks

Mellanox OpenFabric software package MLNX_OFED for Linux and 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 the power and unplug the cord.

4. Remove the card from its package.

> Please note that if the card is removed hastily from the antistatic bag, the plastic ziplock may harm the EMI fingers on the QSFP connector. Carefully remove the card from the antistatic bag to avoid damaging the EMI fingers. See Figure 4 and Figure 5.

Figure 1: EMI fingers on QSFP28 Cage
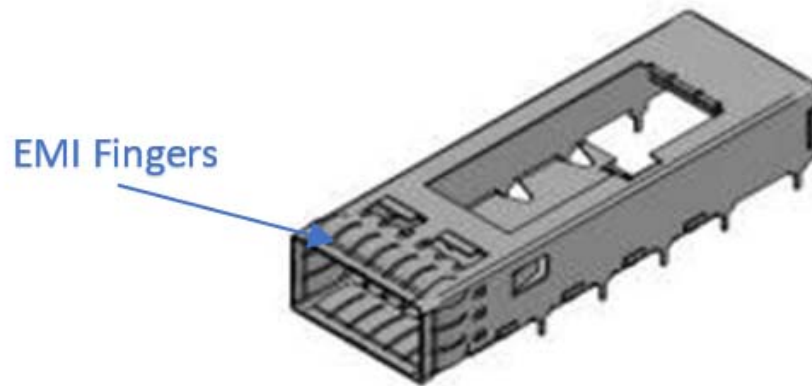
5. Please note that the card must be placed on an antistatic surface.

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 is usually shipped with a tall bracket 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 12. If you need to replace it 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 bracket 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. 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

3.4.2 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. Applying even pressure at both corners of the card, insert the adapter card into the PCI Express slot until firmly seated.
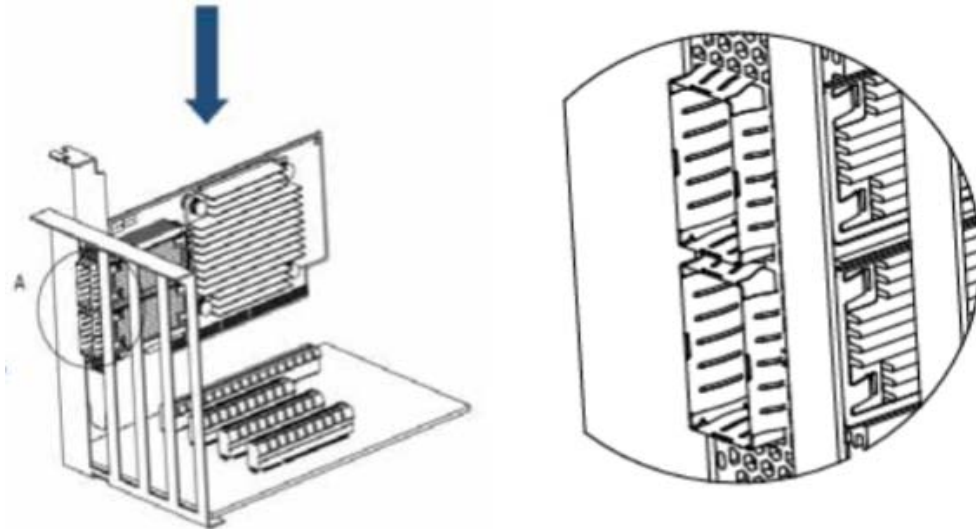
4. When the adapter is properly seated, the port connectors are aligned with the slot opening, and the adapter faceplate is visible against the system chassis.
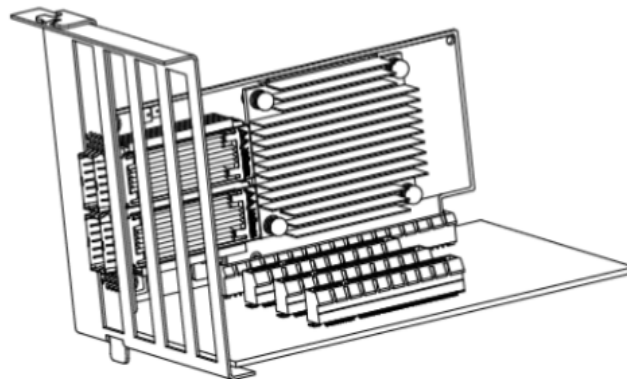
5. Secure the adapter with the adapter clip or screw.

6. Close the system case.

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

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, theAmber 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 7.5, "Adapter Card LED Operations", on page 55.

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 7.5, "Adapter Card LED Operations", on page 55.

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 Un-installation Instructions

3.7.1   Safety Precautions

> The adapter is installed in a system that operates with voltages that can be lethal. Before un-installing the adapter card, 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   Card Un-installation

> Please note that the following images are for illustration purposes only.

1. Verify that the system is powered off and unplugged.

2. Wait 30 seconds.

3. To remove the card, disengage the retention mechanisms on the bracket (clips or screws).

4. Holding the adapter card from its center, gently pull the adapter card from the PCI Express slot.
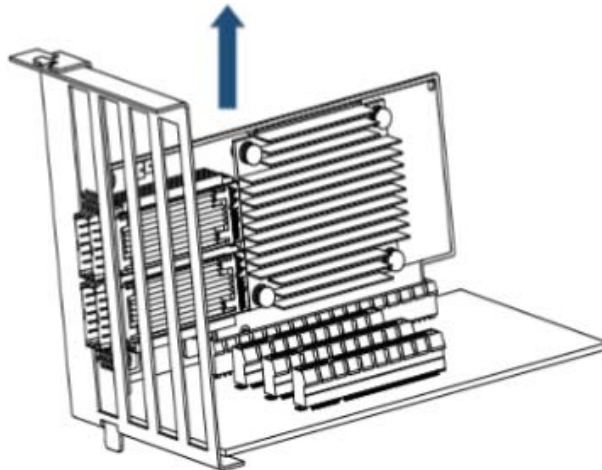
5. When the port connectors reach the top of the chassis window, gently pull the adapter card in parallel to the motherboard.
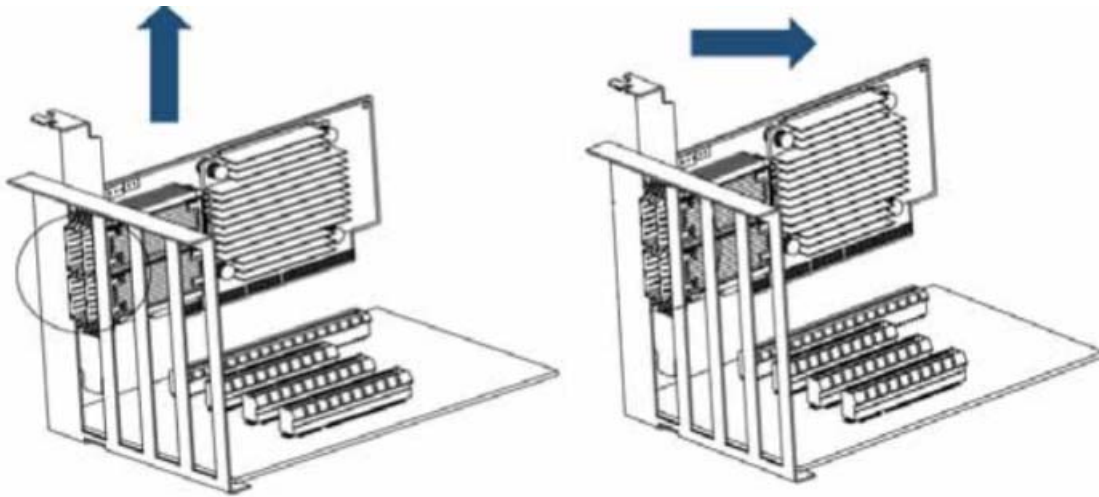
3.8 Identify the Card in Your System

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.

Figure 2: PCI Device (Example)
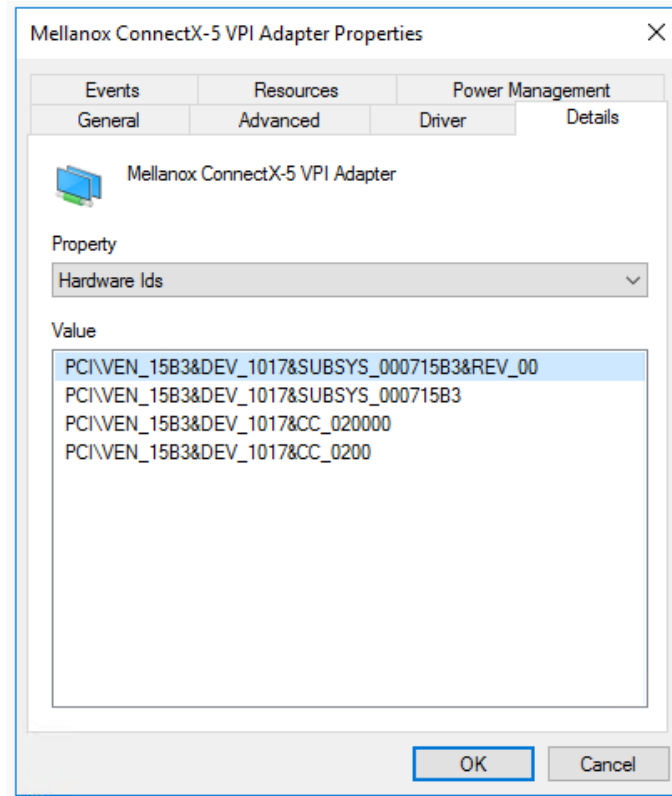
5. In the Value display box, check the fields VEN and DEV (fields are separated by '&'). In the display example above, notice the sub-string "PCI\VEN_15B3&DEV_1003": VEN is equal to 0x15B3 – this is the Vendor ID of Mellanox Technologies; and DEV is equal to 1018 (for ConnectX-5) – this is a valid Mellanox 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 5 - Hardware and Software Requirements

Requirements	Description
Platforms	A server platform with an adapter card based on one of the following Mellanox Technologies' InfiniBand/VPI HCA devices: • MT4121 ConnectX®-5 Ex (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.

The following example shows a system with an installed Mellanox HCA:

```
# lspci -v | grep Mellanox
86:00.0 Network controller [0207]: Mellanox Technologies MT27620 Family
        Subsystem: Mellanox Technologies Device 0014
86:00.1 Network controller [0207]: Mellanox Technologies MT27620 Family
        Subsystem: Mellanox Technologies Device 0014
```

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 automatically[1] 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".

- 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).

---

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

- 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:      MCX556A-EDAT
  Description:      ConnectX®-5 Ex VPI adapter card, EDR IB
(100Gb/s) and 100GbE, dual-port QSFP28, PCIe4.0 x16, tall
bracket, ROHS R6 ConnectX®-5 Ex VPI adapter card, EDR IB (100Gb/
s) and 100GbE, dual-port QSFP28, PCIe4.0 x16, tall bracket, ROHS
R6 ConnectX®-5 Ex VPI adapter card, EDR IB (100Gb/s) and 100GbE,
dual-port QSFP28, PCIe4.0 x16, 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:      MCX556A-EDATMCX556A-EDAT
  Description:
  ConnectX®-5 Ex VPI adapter card, EDR IB (100Gb/s) and 100GbE,
dual-port QSFP28, PCIe4.0 x16, tall bracket, ROHS R6 ConnectX®-5
Ex VPI adapter card, EDR IB (100Gb/s) and 100GbE, dual-port
QSFP28, PCIe4.0 x16, tall bracket, ROHS R6 ConnectX®-5 Ex VPI
adapter card, EDR IB (100Gb/s) and 100GbE, dual-port QSFP28,
PCIe4.0 x16, tall bracket, ROHS R6 ConnectX®-5 Ex VPI adapter
card, EDR IB (100Gb/s) and 100GbE, dual-port QSFP28, PCIe4.0 x16,
tall bracket, ROHS R6 ConnectX®-5 Ex VPI adapter card, EDR IB
(100Gb/s) and 100GbE, dual-port QSFP28, PCIe4.0 x16, 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:

- ConnectX-5/ConnectX-5 Ex - perform a standard reboot

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 6 - Installation Results

Software	• Most of MLNX_OFED packages are installed under the "/usr" directory except for the following packages which are installed under the "/opt" directory:
	  • fca and ibutils
	• The kernel modules are installed under
	  • /lib/modules/`uname -r`/updates on SLES and Fedora Distributions
	  • /lib/modules/`uname -r`/extra/mlnx-ofa_kernel on RHEL and other RedHat like Distributions

Firmware	• The firmware of existing network adapter devices will be updated if the following two conditions are fulfilled:
	  • 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
	   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.
	• In case that your machine has an unsupported network adapter device, no firmware update will occur and the error message below will be printed.
	<pre>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.</pre>

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-inter-faces/ 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 7 - 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 mst driver

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@mel-
lanox.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-isert = 1.0-OFED.3.1.0.1.2.1.g832a737.rhel7u1 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 pacakge 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 Online

To update the device online on the machine from Mellanox site, use the following command line:

```
mlxfwmanager --online -u -d <device>
```

Example:

```
mlxfwmanager --online -u -d 0000:09:00.0
Querying Mellanox devices firmware ...


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


 Device Type:      ConnectX-5
 Part Number:      MCX556A-EDAT
 Description:      ConnectX®-5 Ex VPI adapter card, EDR IB (100Gb/s) and
100GbE, dual-port QSFP28, PCIe4.0 x16, tall bracket, ROHS R6
 PSID:            MT_1020120019
 PCI Device Name: 0000:09:00.0
 Port1 GUID:      0002c9000100d051
 Port2 MAC:       0002c9000002
 Versions:        Current        Available
 FW               2.32.5000      2.33.5000


 Status:          Update required
 ---------
 Found 1 device(s) requiring firmware update. Please use -u flag to perform the update.
```

4.1.6.2 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.

4.1.6.3 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 massage 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 8 - 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/VPIDrivers => Windows SW/Drivers.

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

```
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.
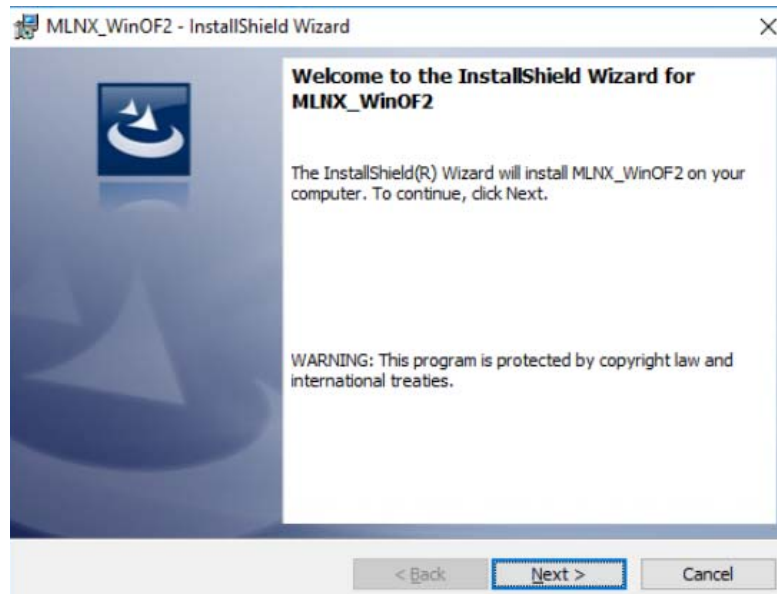
Step 5. Read then accept the license agreement and click Next.
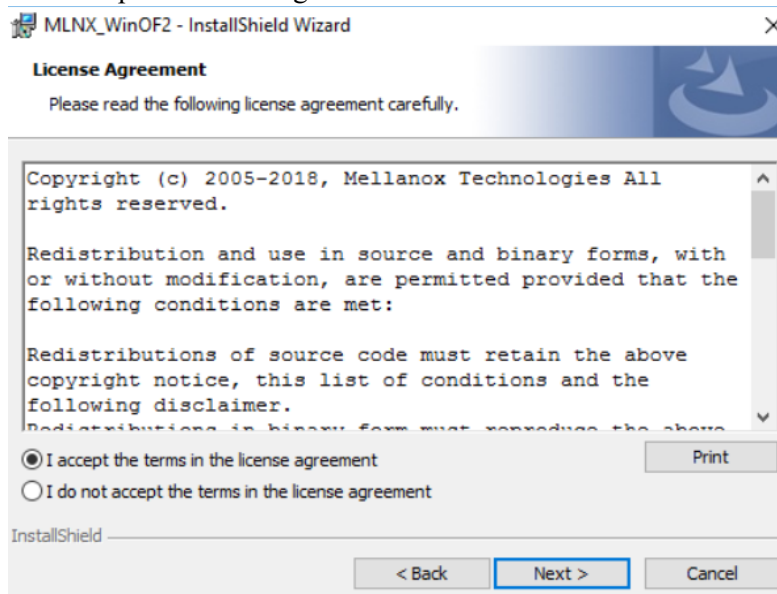
Step 6. Select the target folder for the installation.
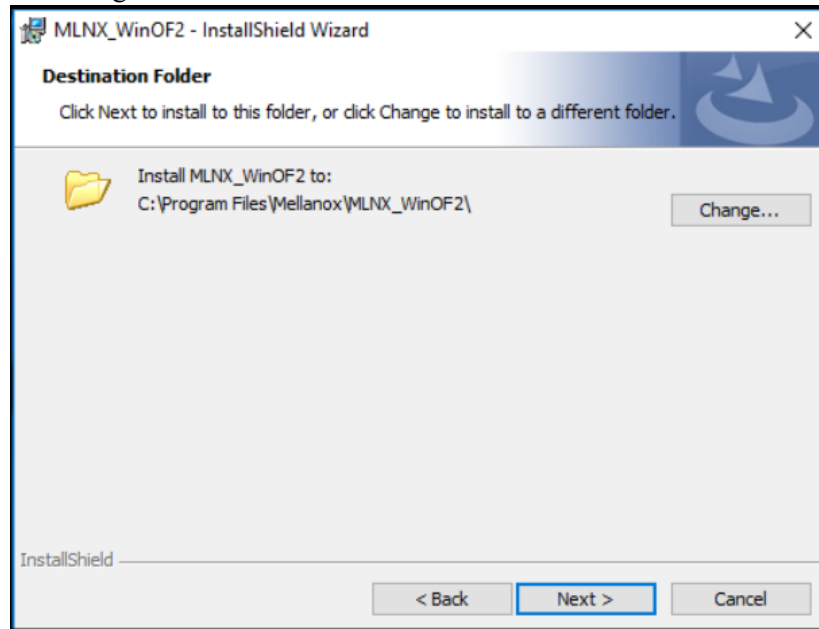
Step 7. The firmware upgrade screen will be displayed in the following cases:

- 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.
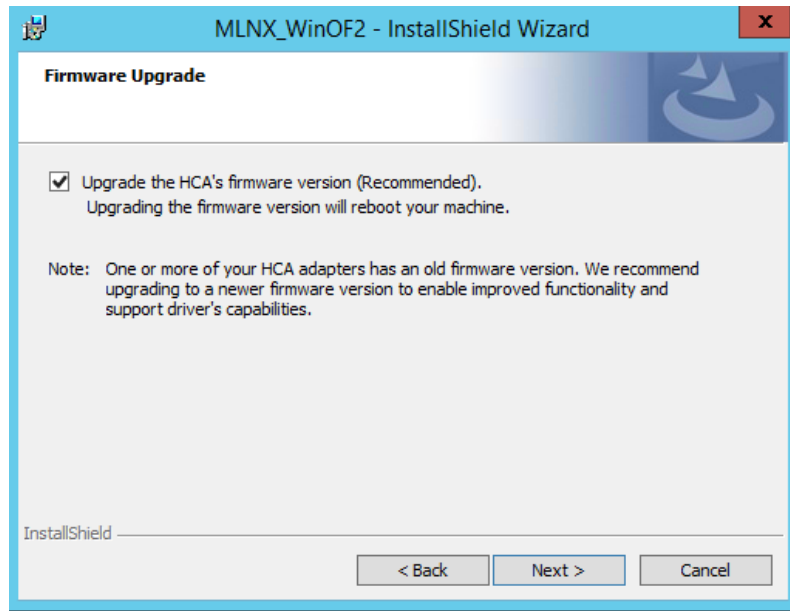
Step 8. Select a Complete or Custom installation, follow Step a and on.
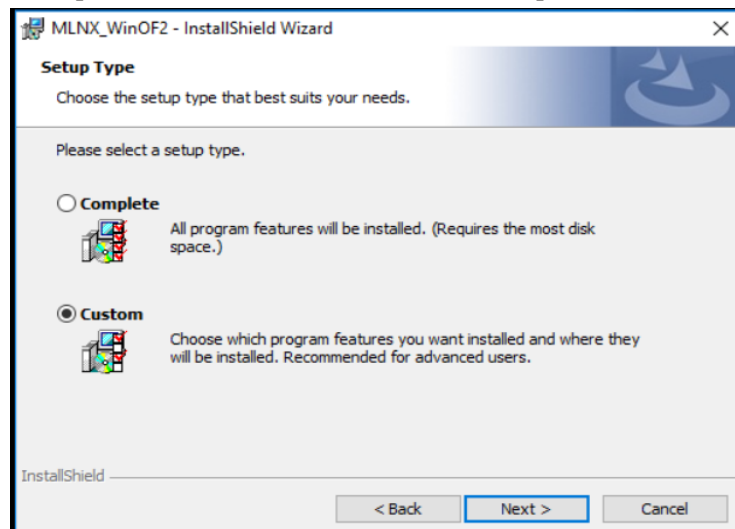
a. Select the desired feature to install:

- 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
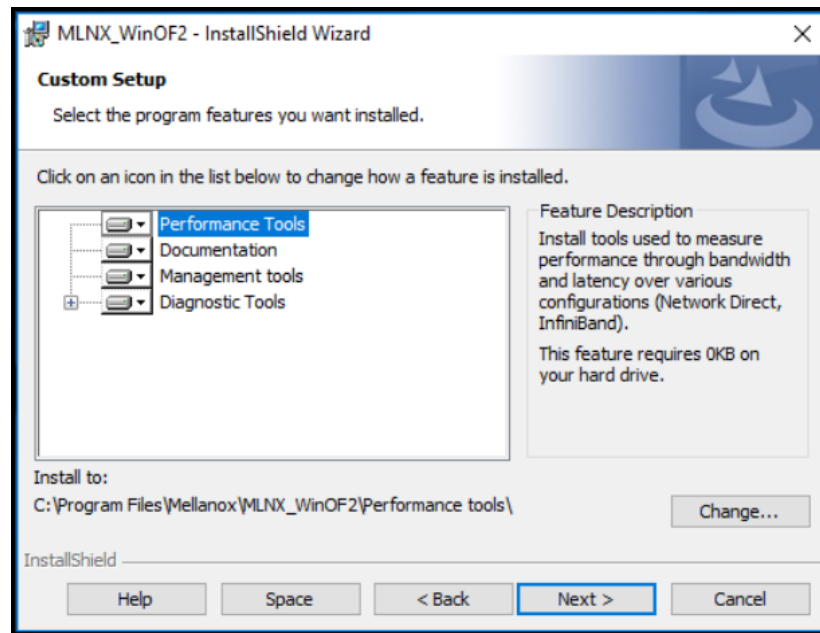
b. Click Next to install the desired tools.

Step 9. Click Install to start the installation.
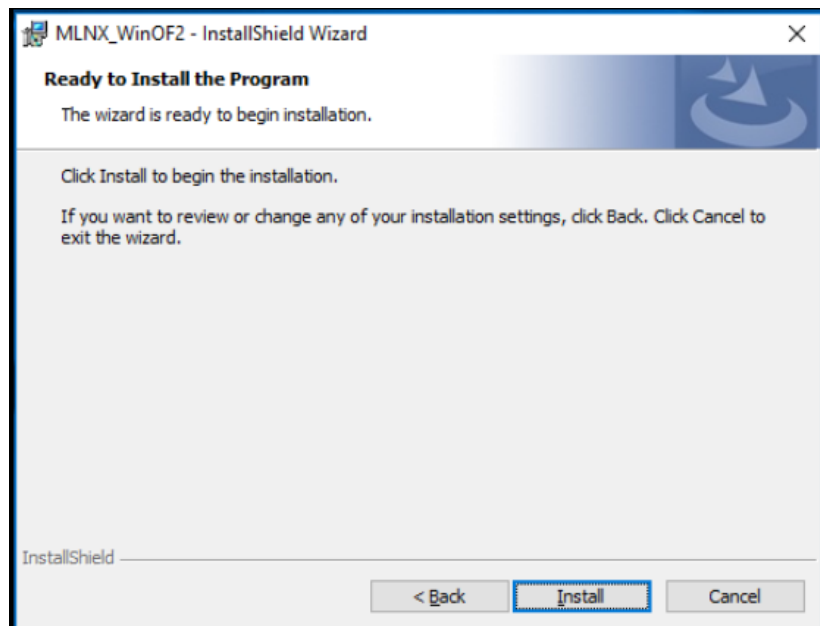
Step 10. In case that firmware upgrade option was checked in <Xref>Step 7, you will be notified if a firmware upgrade is required (See
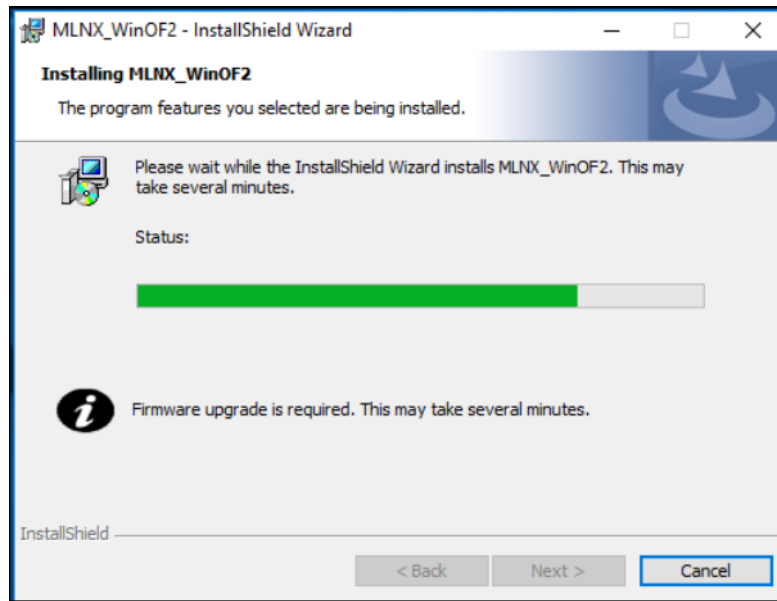
Step 11. Click Finish to complete the installation.
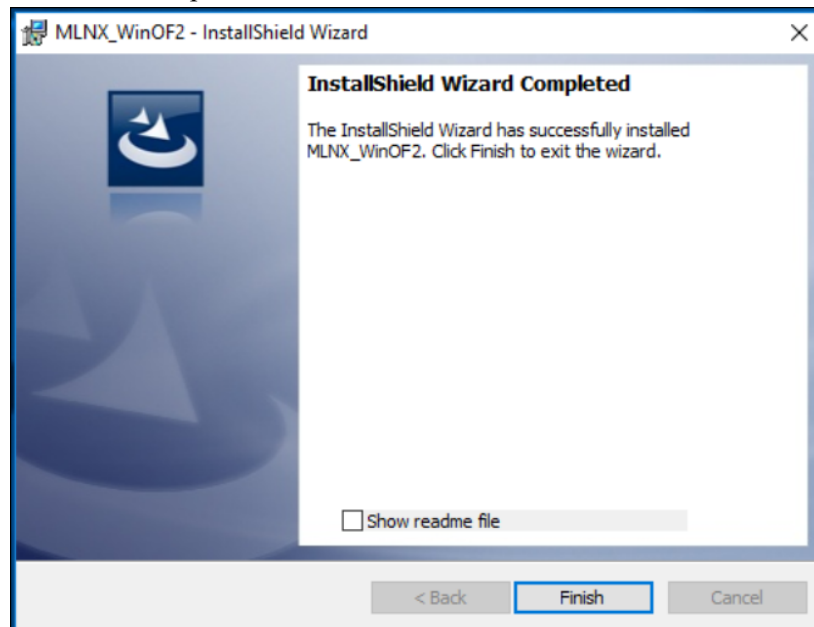
4.2.3.2 Unattended Installation

> 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 not[1].

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

Step 5. [Optional] If you do not wish to upgrade your firmware version[2].

```
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 3: Installation Results
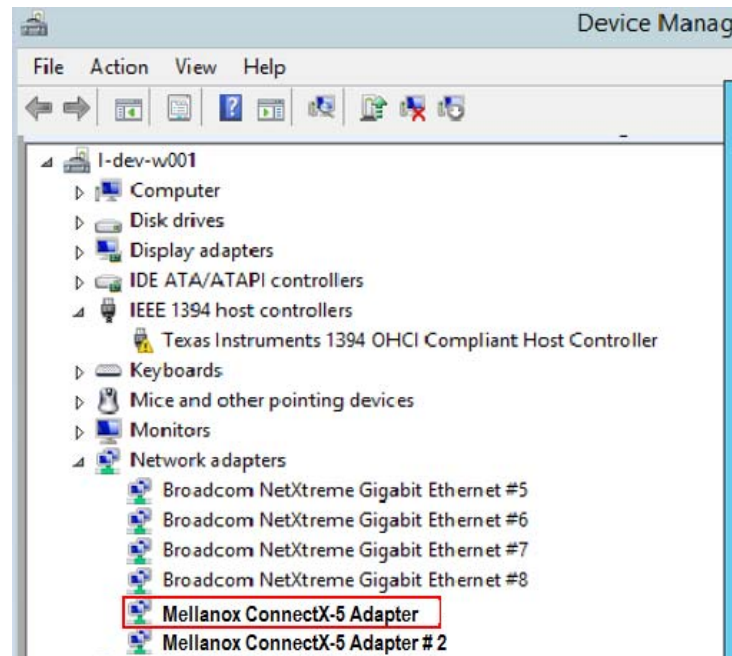
4.2.5 Extracting Files Without Running Installation

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.
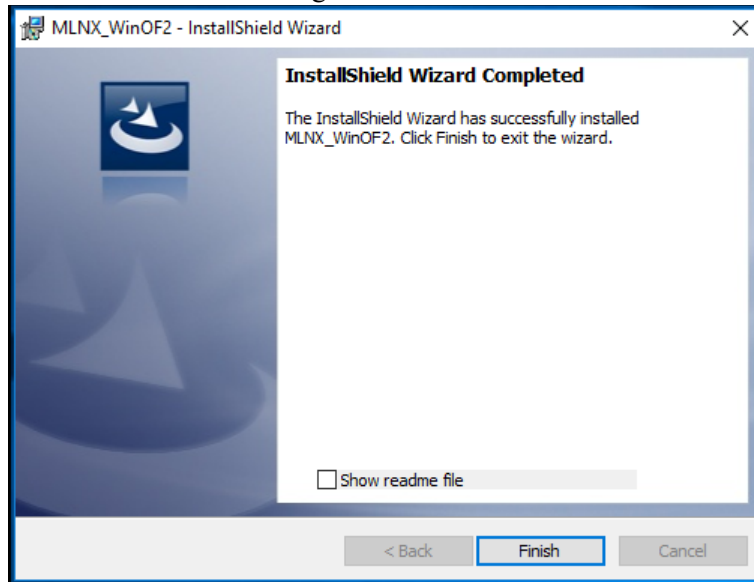
Step 4. Click Change and specify the location in which the files are extracted to.
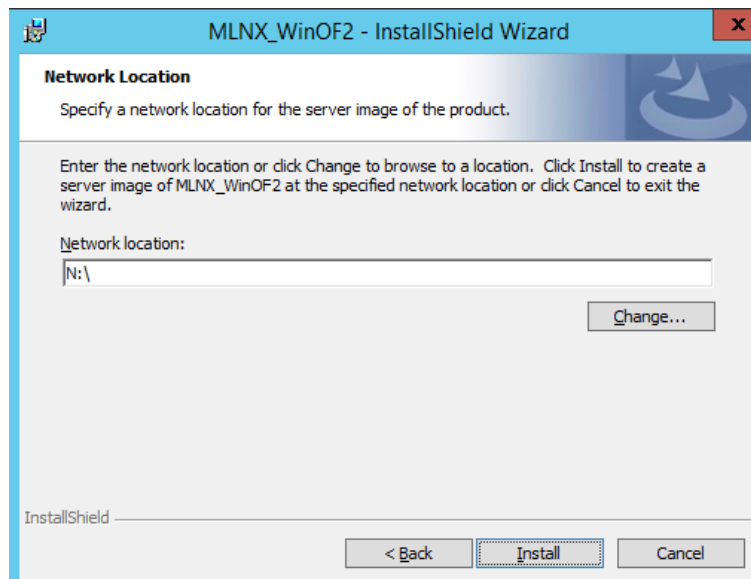
Step 5. Click Install to extract this folder, or click Change to install to a different folder.
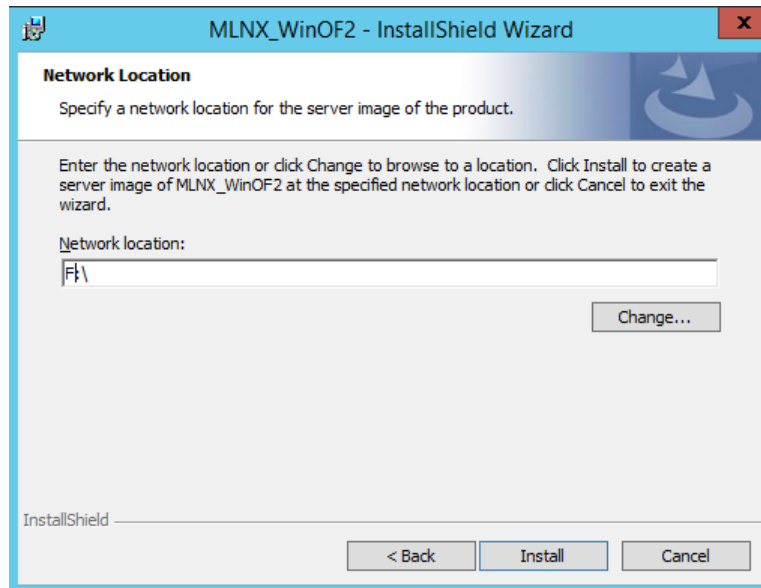
Step 6. To complete the extraction, click Finish.
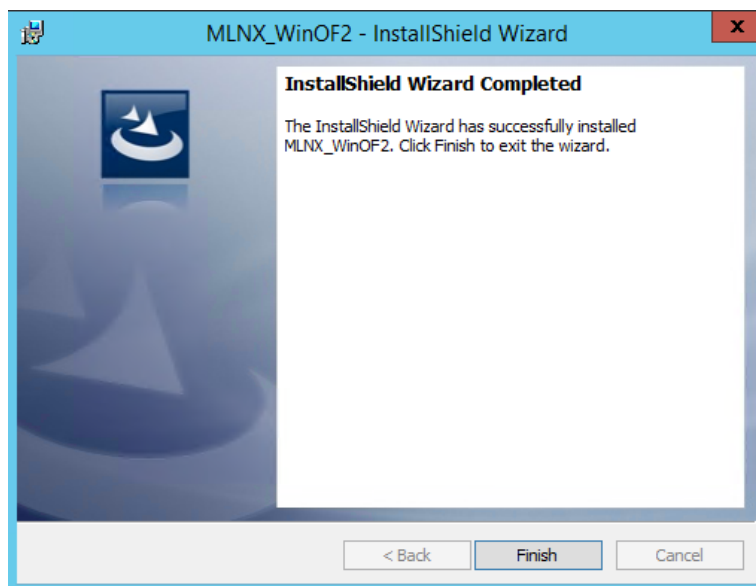
4.2.6 Uninstalling Mellanox WinOF-2 Driver

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 => InfiniBand/VPIEthernet 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/VPIDrivers => 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 43).

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

The directory contents should appear as follows:
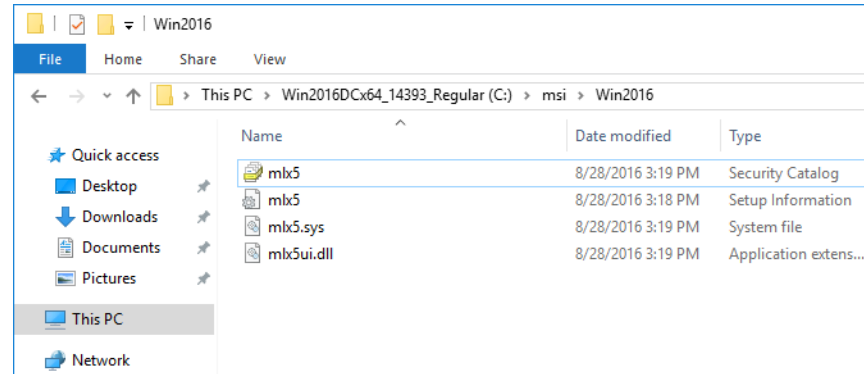
This location should be specified for DriversPath property when injecting driver into the Nano server image:

```
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 43).

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:       MCX556A-EDAT
Description:       ConnectX®-5 Ex VPI adapter card, EDR IB (100Gb/s) and
100GbE, dual-port QSFP28, PCIe4.0 x16, 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:       MCX556A-EDAT
Description:       ConnectX®-5 Ex VPI adapter card, EDR IB (100Gb/s) and 100GbE, dual-port
QSFP28, PCIe4.0 x16, 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 9 - General Troubleshooting

Server unable to find the adapter	• 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
The adapter no longer works	• 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
Adapters stopped working after installing another adapter	• Try removing and re-installing all adapters • Check that cables are connected properly • Make sure your motherboard has the latest BIOS
Link indicator light is off	• Try another port on the switch • Make sure the cable is securely attached • Check you are using the proper cables that do not exceed the recommended lengths • Verify that your switch and adapter port are compatible
Link light is on, but with no communication established	• 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 10 - Linux Troubleshooting

Environment Information	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
Card Detection	lspci | grep -i Mellanox
Mellanox Firmware Tool (MFT)	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. Once installed, run: mst start mst status flint -d <mst_device> q
Ports Information	ibstat ibv_devinfo
Firmware Version Upgrade	To download the latest firmware version refer to http://www.mellanox.com/supportdownloader
Collect Log File	cat /var/log/messages dmesg >> system.log journalctl (Applicable on new operating systems) cat /var/log/syslog

6.3 Windows

Table 11 - Windows Troubleshooting

Environment Information	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.
Mellanox Firmware Tool (MFT)	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. Once installed, open a CMD window and run: WinMFT mst start mst status flint –d <mst_device> q
Ports Information	vstat
Firmware Version Upgrade	Download the latest firmware version using the PSID/board ID: http://www.mellanox.com/supportdownloader/ flint –d <mst_device> –i <firmware_bin_file> b

Collect Log File	• Event log viewer
	• MST device logs:
	  • mst start
	  • mst status
	• flint –d <mst_device> dc > dump_configuration.log
	• mstdump <mst_device> dc > mstdump.log

7   Specifications

7.1   MCX555A-ECAT Specifications

Table 12 - MCX555A-ECAT Specification Table

Physical	**Size:** 2.71 in. x 5.6 in. (68.90mm x 142.24 mm) – low profile		
	Connector: Single QSFP28 InfiniBand and Ethernet (copper and optical)		
Protocol Support	**InfiniBand**: IBTA v1.3[a] Auto-Negotiationa: 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	**InfiniBand**	SDR/DDR/QDR/FDR/EDR
		Ethernet	1/10/25/40/50/100 Gb/s
	PCI Express Gen3: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)		
Power and Environmental	**Voltage:** 12V		
	Power	**Cable**	
	Typical Power[b]	**Passive Cables**	14.2W
	Maximum Power	**Passive Cables**	17.0W
		1.5W Active Cables	18.6W
		2.5W Active Cables	19.7W
	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 MCX556A-ECAT Specifications

Table 13 - MCX556A-ECAT Specification Table

Physical	**Size:** 2.71 in. x 5.6 in. (68.90mm x 142.24 mm) – low profile
	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	**InfiniBand**	SDR/DDR/QDR/FDR/EDR
		Ethernet	1/10/25/40/50/100 Gb/s
	PCI Express Gen3: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible) *Note: PCIe 3.0 x16 bus can supply a maximum bandwidth of 128Gb/s only (=16 * 8GT/s, including overhead), and therefore cannot support 200Gb/s when both network ports of MCX556A-ECAT run at 100Gb/s.*		

Power and Environmental	**Voltage:** 12V		
	Power	**Cable**	
	Typical Power[b]	**Passive Cables**	16.2W
	Maximum Power	**Passive Cables**	19.0W
		1.5 Active Cables	22.3W
		2.5W Active Cables	24.6W
	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 InfiniBand product.
b. Typical power for ATIS traffic load.
c. For both operational and non-operational states.

7.3   MCX556A-EDAT Specifications

Table 14 - MCX556A-EDAT Specification Table

Physical	Size: 2.71 in. x 5.6 in. (68.90mm x 142.24 mm) – low profile		
	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	InfiniBand	SDR/DDR/QDR/FDR/EDR
		Ethernet	1/10/25/40/50/100 Gb/s
	PCI Express Gen3: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible) *Note: PCIe 3.0 x16 bus can supply a maximum bandwidth of 128Gb/s only (=16 * 8GT/s, including overhead), and therefore cannot support 200Gb/s when both network ports of MCX556A-ECAT run at 100Gb/s.*		
Power and Environmental	Voltage: 12V		
	Power	**Cable**	
	Typical Power[b]	Passive Cables	19.3W
	Maximum Power	Passive Cables	23.4W
		1.5W Active Cables	26.8W
		2.5W Active Cables	29.0W
	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 InfiniBand product.
b. Typical power for ATIS traffic load.
c. For both operational and non-operational states.

7.4   Airflow Specifications

Table 15 - Airflow Specifications

Air Flow (LFM)[a] Air Flow Direction - Heat Sink to Port					
Cable Type	Passive	Active 1.5W	Active 2.5W	Active 3.5W	Active 5W
MCX555A-ECAT	300	350	400	400	950
MCX556A-ECAT	350	500	600	650	1300
MCX556A-EDAT	400	600	850	1000	1400

a. Cells marked with (–) are not applicable

7.5   Adapter Card LED Operations

There is one bi-color I/O LED per port to indicate link status. See Table 16.

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

LED Color and State	Description
Off	A link has not been established
Blinking Amber[a]	4 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 17 - 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]	4 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.

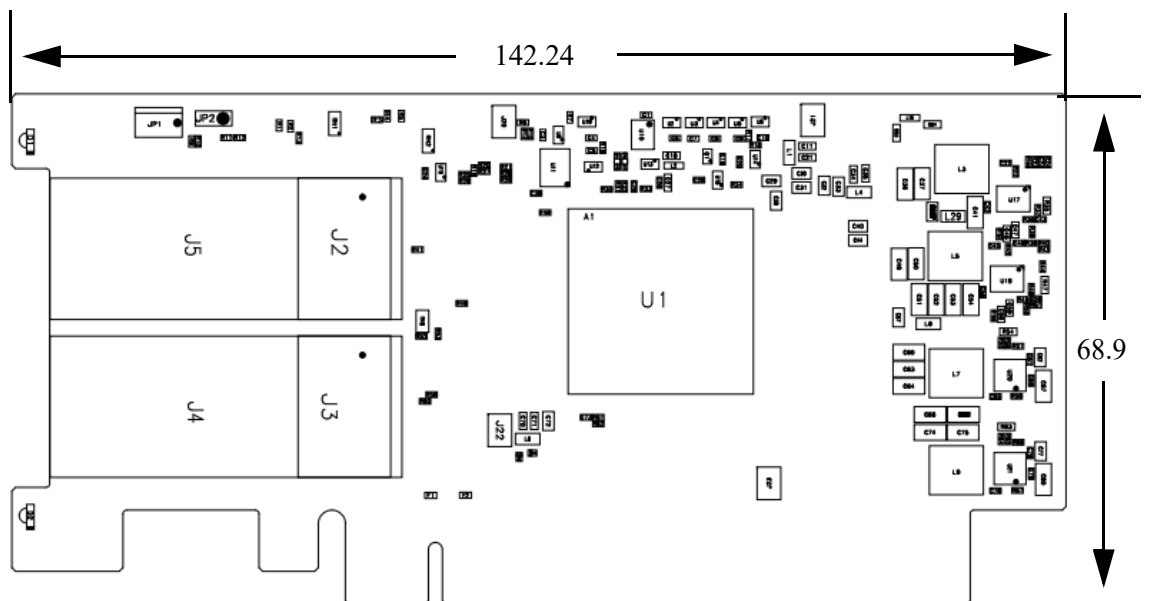## 7.6   Board Mechanical Drawing and Dimensions

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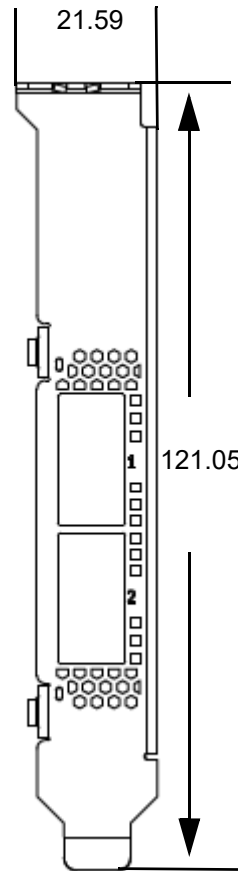> All the mechanical tolerances are +/- 0.1mm.

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> For the 3D Model of the card, please refer to 3D Models.

Figure 4: Mechanical Drawing of the Dual-port Adapter Cards

7.7 Bracket Mechanical Drawing

Figure 5: Dual-port Tall Bracket

Appendix A: 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 6: MCX555A-ECAT Board Label (Example)

Figure 7: MCX556A-ECAT Board Label (Example)

Figure 8: MCX556A-EDAT Board Label (Example)

Appendix B: Safety Warnings

B.1 Safety Warnings in English

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.

B.2   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

B.3   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. Strahlenkontak

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

B.4 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. Sobrecalentamiento

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