NVIDIA ConnectX-6 Dx Ethernet Adapter Cards User Manual

Exported on Sep/16/2022 01:57 PM

Table of Contents

Introduction 9
Product Overview 9
Features and Benefits 13
Operating Systems/Distributions 15
Connectivity 16
Interfaces 17
ConnectX-6 Dx IC Interface 18
Encryption 18
PCI Express Interface 18
Networking Ports LEDs Interface 19
Scheme 1: One Bi-Color LED 19
Scheme 2: One Bi-Color LED and one Single Color LED 20
Voltage Regulators 20
Heatsink 21
Thermal Sensors 21
Hardware Installation 22
Safety Warnings 22
Installation Procedure Overview 22
System Requirements 23
Safety Precautions 23
Unpacking the Package 24
Pre-Installation Checklist 24
Bracket Replacement Instructions 25
Installation Instructions 25
Cables and Modules 27
Identifying the Card in Your System 28
Uninstalling the Card 29
Driver Installation 31
Linux Driver Installation 31
Prerequisites 31
Downloading MLNX_OFED 31
Installing MLNX_OFED 32

Installing MLNX_OFED Using YUM 37
Installing MLNX_OFED Using apt-get Tool 40
Updating Firmware After Installation 41
UEFI Secure Boot 42
Performance Tuning 44
Windows Driver Installation 44
Software Requirements 44
Downloading WinOF-2 Driver 45
Uninstalling WinOF-2 Driver 52
Extracting Files Without Running Installation 53
Firmware Upgrade 55
VMware Driver Installation 55
Hardware and Software Requirements 55
Installing NATIVE ESXi Driver for VMware vSphere 56
Removing Earlier NVIDIA Drivers 56
Firmware Programming 57
Updating Adapter Firmware 58
Troubleshooting 59
General Troubleshooting 59
Linux Troubleshooting 60
Windows Troubleshooting 60
Specifications 62
MCX621102AC-ADAT / MCX621102AN-ADAT / MCX621102AN-ADAT Specifications 62
MCX623102AC-ADAT / MCX623102AN-ADAT / MCX623102AS-ADAT Specifications 63
MCX621202AS-ADAT / MCX621202AC-ADAT Specifications 64
MCX623102AC-GDAT / MCX623102AE-GDAT / MCX623102AN-GDAT / MCX623102AS-GDAT Specifications 65
MCX623105AN-CDAT / MCX623105AE-CDAT / MCX623105AC-CDAT Specifications 66
MCX623106AS-CDAT / MCX623106AN-CDAT / MCX623106AC-CDAT / MCX623106AE-CDAT Specifications 67
MCX623106PN-CDAT / MCX623106PC-CDAT Specifications 69
MCX623106TC-CDAT / MCX623106TN-CDAT / MCX623106GN-CDAT / MCX623106GC-CDAT Specifications 70
MCX623105AC-VDAT / MCX623105AN-VDAT / MCX623105AS-VDAT / MCX623105AE-VDAT Specifications 71

Board Mechanical Drawing and Dimensions 72
Bracket Mechanical Drawing 73
Finding the MAC on the Adapter Card 75
Document Revision History 76

About This Manual

This User Manual describes NVIDIA® ConnectX®-6 Dx Ethernet adapter cards. It provides details as to the interfaces of the board, specifications, required software and firmware for operating the board, and relevant documentation.

Ordering Part Numbers

The table below provides the ordering part numbers (OPN) for the available ConnectX-6 Dx Ethernet adapter cards.

Configuration	OPN	Marketing Description
25GbE Cards	MCX621102AN-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x8**, No Crypto, Tall Bracket
	MCX623102AS-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x16**, **Secure Boot**, No Crypto, Tall Bracket
25GbE with Active Cooling Cards	MCX621202AS-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **with active cooling**, **Dual**-port **SFP28**, PCIe 4.0 **x8**, **Secure Boot**, No Crypto, Tall Bracket
	MCX621202AC-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **with active cooling**, **Dual**-port **SFP28**, PCIe 4.0 **x8**, **Crypto and Secure Boot**, Tall Bracket
50GbE Cards	MCX623102AC-GDAT	ConnectX-6 Dx EN adapter card, **50GbE**, **Dual**-port **SFP56,** PCIe 4.0 **x16**, **Crypto and Secure Boot,** Tall Bracket
100GbE Cards	MCX623105AN-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Single**-port **QSFP56**, PCIe 4.0 **x16**, No Crypto, Tall Bracket
	MCX623106AC-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, PCIe 4.0 **x16**, **Crypto and Secure Boot,** Tall Bracket
	MCX623106AN-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, PCIe 4.0 **x16**, No Crypto, Tall Bracket
	MCX623106AS-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, PCIe 4.0 **x16**, **Secure Boot**, No Crypto, Tall Bracket
100GbE with PPS In/Out Cards	MCX623106PC-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, with **PPS In/Out**, PCIe 4.0 **x16**, **Crypto** and **Secure Boot**, Tall Bracket

Configuration	OPN	Marketing Description
	MCX623106TC-CDAT	ConnectX-6 Dx EN adapter card, 100GbE, **Dual**-port **QSFP56**, **Enhanced-SyncE & PTP**, **PPS In/Out**, PCIe 4.0 x16, **Crypto and Secure Boot**, Tall Bracket
	MCX623106GC-CDAT	ConnectX-6 Dx EN adapter card, 100GbE, **Dual**-port **QSFP56**, **Enhanced-SyncE & PTP GM support and GNSS**, PPS Out, PCIe 4.0 x16, **Crypto and Secure Boot**, Tall Bracket
200GbE Cards	MCX623105AC-VDAT	ConnectX-6 Dx EN adapter card, **200GbE**, **Single**-port **QSFP56**, PCIe 4.0 **x16**, **Crypto and Secure Boot**, Tall Bracket
	MCX623105AN-VDAT	ConnectX-6 Dx EN adapter card, **200GbE**, **Single**-port **QSFP56**, PCIe 4.0 **x16**, No Crypto, Tall Bracket

Legacy (EOL) Ordering Part Numbers

OPN	Marketing Description
MCX621102AC-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x8**, **Crypto** and **Secure Boot**, Tall Bracket
MCX623102AC-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x16**, **Crypto and Secure Boot**, Tall Bracket
MCX623102AN-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x16**, No Crypto, Tall Bracket
MCX621102AE-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x8**, **Crypto**, No Secure Boot, Tall Bracket
MCX623102AN-GDAT	ConnectX-6 Dx EN adapter card, **50GbE** , **Dual**-port **SFP56**, PCIe 4.0 **x16**, No Crypto, Tall Bracket
MCX623102AE-GDAT	ConnectX-6 Dx EN adapter card, **50GbE**, **Dual**-port **SFP56**, PCIe 4.0 **x16**, **Crypto**, No Secure Boot, Tall Bracket
MCX623102AS-GDAT	ConnectX-6 Dx EN adapter card, **50GbE**, **Dual**-port **SFP56**, PCIe 4.0 **x16**, **Secure Boot**, No Crypto, Tall Bracket
MCX623105AC-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, Single-port **QSFP56**, PCIe 4.0 **x16**, **Crypto and Secure Boot**, Tall Bracket
MCX623105AE-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Single**-port **QSFP56**, PCIe 4.0 **x16**, **Crypto**, No Secure Boot, Tall Bracket
MCX623106AE-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, PCIe 4.0 **x16**, **Crypto**, No Secure Boot, Tall Bracket
MCX623109AC-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, Single-port DSFP, PCIe 4.0 x16, **Crypto and Secure Boot**, Tall Bracket
MCX623109AN-CDAT	ConnectX-6 Dx EN adapter card, **100GbE** , Single-port DSFP, PCIe 4.0 x16, No Crypto, Tall Bracket

OPN	Marketing Description
MCX623106GN-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, **Enhanced-SyncE & PTP GM support and GNSS**, **PPS Out**, PCIe 4.0 x16, No Crypto, Tall Bracket
MCX623106PC-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, with **PPS In/Out**, PCIe 4.0 x16, **Crypto** and Secure Boot, Tall Bracket
MCX623106PE-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, with **PPS In/Out**, PCIe 4.0 x16, **Crypto**, No Secure Boot, Tall Bracket
MCX623106PN-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, with **PPS In/Out**, PCIe 4.0 **x16**, No **Crypto**, Tall Bracket
MCX623106TN-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, with **PPS In/Out**, PCIe 4.0 **x16**, No **Crypto**, Tall Bracket
MCX623105AE-VDAT	ConnectX-6 Dx EN adapter card, **200GbE**, **Single**-port **QSFP56**, PCIe 4.0 **x16**, **Crypto**, No Secure Boot, Tall Bracket
MCX623105AS-VDAT	ConnectX-6 Dx EN adapter card, **200GbE**, **Single**-port **QSFP56**, PCIe 4.0 **x16**, **Secure Boot**, No Crypto, Tall Bracket

Intended Audience

This manual is intended for the installer and user of these cards. The manual assumes basic familiarity with Ethernet network and architecture specifications.

Technical Support

Customers who purchased NVIDIA products directly from NVIDIA are invited to contact us through the following methods:

- URL: https://www.nvidia.com > Support
- E-mail: Network-support@nvidia.com

Customers who purchased NVIDIA M-1 Global Support Services, please see your contract for details regarding Technical Support.
Customers who purchased NVIDIA products through an NVIDIA-approved reseller should first seek assistance through their reseller.

Related Documentation

NVIDIA MLNX_OFED for Linux User Manual and Release Notes	User Manual and Release Notes describing MLNx_OFED features, performance, band diagnostic, tools content, and configuration. See NVIDIA MLNX_OFED for Linux Documentation.
WinOF-2 for Windows User Manual and Release Notes	User Manual describing WinOF-2 features, performance, Ethernet diagnostic, tools content, and configuration. See WinOF-2 for Windows Documentation.
NVIDIA VMware for Ethernet User Manual and Release Notes	User Manual describing the various components of the NVIDIA ConnectX® NATIVE ESXi stack. See VMware® ESXi Documentation.

NVIDIA MLNX_OFED for Linux User Manual and Release Notes	User Manual and Release Notes describing MLNx_OFED features, performance, band diagnostic, tools content, and configuration. See NVIDIA MLNX_OFED for Linux Documentation.
NVIDIA Firmware Update	NVIDIA firmware update and query utility used to update the firmware. See NVIDIA Firmware Utility (mlxup) Documentation.
NVIDIA Firmware Tools (MFT) User Manual	User Manual describing the set of MFT firmware management tools for a single node. See MFT User Manual.
IEEE Std 802.3 Specification	IEEE Ethernet Specifications
PCI Express Specifications	Industry Standard PCI Express Base and Card Electromechanical Specifications.
LinkX Interconnect Solutions	LinkX Ethernet cables and transceivers are designed to maximize the performance of High-Performance Computing networks, requiring high-bandwidth, low-latency connections between compute nodes and switch nodes. NVIDIA offers one of the industry's broadest portfolio of 40GbE, 56GbE, 100GbE, 200GbE and 400GbE cables, including Direct Attach Copper cables (DACs), copper splitter cables, Active Optical Cables (AOCs) and transceivers in a wide range of lengths from 0.5m to 10km. In addition to meeting Ethernet standards, NVIDIA tests every product in an end-to-end environment ensuring a Bit Error Rate of less than 1E-15. Read more at LinkX Cables and Transceivers.

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. In this document PCIe is used to mean PCI Express.

Revision History

A list of the changes made to this document are provided in .Document Revision History.

Introduction

Product Overview

This is the *User Manual* for Ethernet adapter cards based on the ConnectX®-6 Dx integrated circuit device.
As the world's most advanced cloud SmartNIC, ConnectX-6 Dx provides up to two ports of 25, 50 or 100Gb/s or a single-port of 200Gb/s Ethernet connectivity, powered by 50Gb/s PAM4 SerDes technology and PCIe Gen 4.0 host connectivity. ConnectX-6 Dx continues among NVIDIA's innovation path in scalable cloud fabrics, delivering unparalleled performance and efficiency at every scale. ConnectX-6 Dx's innovative hardware offload engines, including IPsec and TLS inline data-in-motion encryption, are ideal for enabling secure network connectivity in modern data-center environments. Please refer to Feature and Benefits for more details.

ConnectX-6 Dx 25GbE Adapter Cards

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	RoHS	Bracket Type
MCX621102AC-ADAT	4.89in. x 2.71in (124.22mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x8	✓	✓	✓	Tall Bracket
MCX621102AN-ADAT	4.89in. x 2.71in (124.22mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x8	-	-	✓	Tall Bracket
MCX621102AN-ADAT	4.89in. x 2.71in (124.22mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x8	-	-	✓	Tall Bracket
MCX623102AC-ADAT	5.59in. x 2.71in (142.00mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	Tall Bracket
MCX623102AN-ADAT	5.59in. x 2.71in (142.00mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	Tall Bracket
MCX623102AS-ADAT	5.59in. x 2.71in (142.00mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	-	✓	Tall Bracket

ConnectX-6 Dx 25GbE Adapter Cards with Active Cooling

⚠ These cards are optimized for Workstation Environments and include an onboard cooling fan that meets the acoustic requirements for workstations.

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	RoHS	Bracket Type
MCX621202AS-ADAT	6.01in. x 2.71in (152.90mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x8	✓	-	✓	Tall Bracket
MCX621202AC-ADAT	6.01in. x 2.71in (152.90mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x8	✓	-	✓	Tall Bracket

ConnectX-6 Dx 50GbE Adapter Cards

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	RoHS	Bracket Type
MCX623102AC-GDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	50/25/10/1 GbE	Dual-port SFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	Tall Bracket
MCX623102AE-GDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	25/10/1 GbE	Dual-port SFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	✓	✓	Tall Bracket
MCX623102AN-GDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	25/10/1 GbE	Dual-port SFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	Tall Bracket
MCX623102AS-GDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	25/10/1 GbE	Dual-port SFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	-	✓	Tall Bracket

ConnectX-6 Dx 100GbE Adapter Cards

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	RoHS	Bracket Type
MCX623105AN-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	Tall Bracket
MCX623106AN-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	Tall Bracket
MCX623105AC-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	Tall Bracket
MCX623106AC-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	Tall Bracket
MCX623105AE-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	✓	✓	Tall Bracket
MCX623106AE-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	✓	✓	Tall Bracket
MCX623106AS-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	-	✓	Tall Bracket

ConnectX-6 Dx 100GbE Adapter Cards for Timing and Telecommunication Application SMAs

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	PPS In / Out SMAs	PPS OUT	PPS IN	SyncE & PTP GM Support	GNSS	RoHS	Bracket Type
MCX623106PN-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	✓	✓	-	-	✓	Tall Bracket

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	PPS In / Out SMAs	PPS OUT	PPS IN	SyncE & PTP GM Support	GNSS	RoHS	Bracket Type
MCX623106PC-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	✓	✓	-	-	✓	Tall Bracket
MCX623106TN-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	✓	✓	✓	-	✓	Tall Bracket
MCX623106TC-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	✓	✓	✓	-	✓	Tall Bracket
MCX623106GN-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	✓	-	✓	✓	✓	Tall Bracket
MCX623106GC-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	✓	-	✓	✓	✓	Tall Bracket

ConnectX-6 Dx 200GbE Adapter Cards

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	RoHS	Bracket Type
MCX623105AC-VDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	200/100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	Tall Bracket
MCX623105AE-VDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	200/100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	✓	✓	Tall Bracket
MCX623105AN-VDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	200/100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	Tall Bracket

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	RoHS	Bracket Type
MCX623105AS-VDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	200/100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	-	✓	Tall Bracket

For more detailed information see Specifications.

Features and Benefits

⚠ This section describes hardware features and capabilities. Please refer to the relevant driver and/or firmware release notes for feature availability.

Feature	Description
PCI Express (PCIe)	PCIe Gen 4.0 SERDES@ 8.0GT/s / 16.0GT/s through x8/x16 Edge Connector
Up to 200GbE	NVIDIA adapters comply with the following IEEE 802.3 standards: 200GbE / 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 - 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)
Memory	• PCI Express - stores and accesses Ethernet fabric connection information and packet data. • SPI Quad - includes 256Mbit SPI Quad Flash device (MX25L25645GXDI-08G device by Macronix) • Available only in QSFP cards: FRU EEPROM - Stores the parameters and personality of the card. The EEPROM capacity is 128Kbit. FRU I2C address is (0x50) and is accessible through the PCIe SMBus (Note: Address 0x58 is reserved.)

Feature	Description
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-6 Dx effectively addresses this by providing advanced NVGRE and VXLAN hardware offloading engines that encapsulate and de-capsulate the overlay protocol.
RDMA over Converged Ethernet (RoCE)	ConnectX-6 Dx, utilizing 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-6 Dx, advanced congestion control hardware mechanisms, RoCE provides efficient low-latency RDMA services over Layer 2 and Layer 3 networks.
NVIDIA PeerDirect®	NVIDIA 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-6 Dx advanced acceleration technology enables higher cluster efficiency and scalability to tens of thousands of nodes.
CPU Offload	Adapter functionality enables reduced CPU overhead leaving more CPU resources available 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-6 Dx 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 • RDMA for high-performance storage access • NVMe over Fabric offloads for the target machine
SR-IOV	ConnectX-6 Dx 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

Feature	Description
Time Sensitive Applications	NVIDIA offers a full IEEE 1588v2 PTP software solution, as well as time-sensitive related features called “5T”. NVIDIA PTP and 5T software solutions are designed to meet the most demanding PTP profiles. ConnectX-6 Dx incorporates an integrated Hardware Clock (PHC) that allows ConnectX-6 Dx to achieve sub 20u Sec accuracy and also offers many timing-related functions such as time-triggered scheduling or time-based SND accelerations (time-based ASAP²). Furthermore, 5T technology enables the software application to transmit fronthaul (ORAN) compatible in high bandwidth. The PTP part supports the subordinate clock, master clock, and boundary clock. ConnectX-6 Dx PTP solution allows you to run any PTP stack on your host.
Enhanced-SyncE & PTP	NVIDIA offers ConnectX-6 Dx cards with SyncE support including an improved holdover to meet ITU-T G.8273.2 class C. Enabled in MCX623106TN-CDAT, MCX623106TC-CDAT, MCX623106GN-CDAT, and MCX623106GC-CDAT.
Grand Master (GNSS Reciver)	NVIDIA offers ConnectX-6 Dx with an integrated GNSS receiver to allow a compact and efficient solution for a Grand Master at every server. Enabled in MCX623106G[N/C]-CDAT
PPS In/Out SMAs	NVIDIA offers a full IEEE 1588v2 PTP software solution, as well as time-sensitive related features called “5T”. NVIDIA PTP and 5T software solutions are designed to meet the most demanding PTP profiles. ConnectX-6 Dx incorporates an integrated Hardware Clock (PHC) that allows ConnectX-6 Dx to achieve sub 20u Sec accuracy and also offers many timing-related functions such as time-triggered scheduling or time-based SND accelerations (time-based ASAP²). Furthermore, 5T technology enables the software application to transmit fronthaul (ORAN) compatible in high bandwidth. The PTP part supports the subordinate clock, master clock, and boundary clock. ConnectX-6 Dx PTP solution allows you to run any PTP stack on your host. With respect to testing and measurements, selected NVIDIA adapters allow you to use the PPS-out signal from the onboard SMA connecter, ConnectX-6 Dx also allows measuring PTP in scale, with PPS-In signal. The PTP HW clock on the Network adapter will be sampled on each PPS-In signal, and the timestamp will be sent to the SW. Enabled in MCX623106PN-CDAT, MCX623106PC-CDAT, MCX623106TN-CDAT, MCX623106TC-CDAT, MCX623106GN-CDAT, and MCX623106GC-CDAT.

Operating Systems/Distributions

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

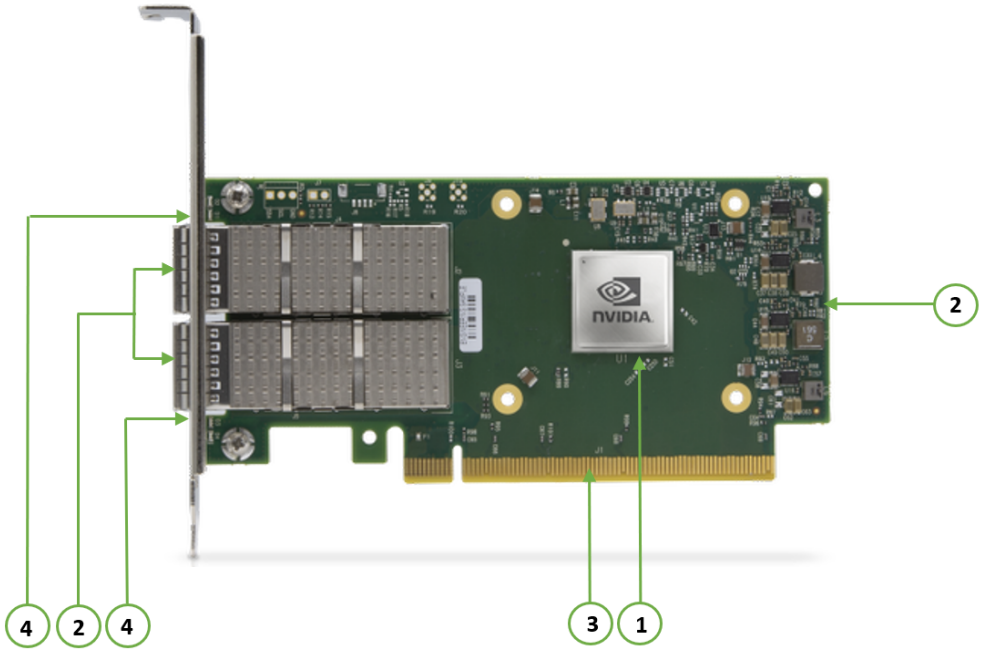
Connectivity

- Interoperable with 1/10/25/40/50/100/200 Gb/s Ethernet switches
- Passive copper cable with ESD protection
- Powered connectors for optical and active cable support

Interfaces

The below figures show the component side of the ConnectX-6 Dx adapter card. Each numbered interface that is referenced in the figures is described in the following table with a link to detailed information.

> The below figures are for illustration purposes only and might not reflect the current revision of the adapter card.



Callout	Item	Description
1	“ConnectX-6 Dx IC”	ConnectX-6 Dx IC on the board.
2	“Ethernet SFP28/SFP56/QSFP56 Interface”	Ethernet traffic is transmitted through the adapter's SFP28/SFP56/QSFP56 connectors. The networking connectors allow for the use of modules, optical and passive cable interconnect solutions.
3	"PCI Express Interface"	PCIe Gen 3.0/4.0 through an x8/x16 edge connector.
4	“Networking Ports LEDs Interface”	There are two I/O LEDs per port to indicate speed and link status.
	“SMBus Interface”	Allows BMC connectivity using MCTP over SMBus or MCTP over PCIe protocols.
	“Voltage Regulators”	Voltage supply pins that feed onboard regulators.

ConnectX-6 Dx IC Interface

The ConnectX®-6 Dx EN family of adapter IC devices delivers two ports of 10/25/40/50/100Gb/s or a single-port of 200Gb/s Ethernet connectivity paired with best-in-class hardware capabilities that accelerate and secure cloud and data-center workloads.

Encryption

⚠ Applies to Crypto OPNs only.

ConnectX-6 Dx brings security to every end-point, including:

- Purpose-built inline acceleration engines that offload IPsec and TLS data-in-motion and XTS-AES data-at-rest cryptographic operations.
- Stateful firewall solution acceleration, powered by Open vSwitch connection tracking and NVIDIA's ASAP2 technology.
- Embedded hardware root-of-trust and support for RSA-based secure firmware update and secure boot, providing guaranteed integrity of the network adapter.

Ethernet SFP28 / SFP56 / QSFP56 Interfaces

The network ports of the ConnectX-6 Dx adapter card are compliant with the IEEE 802.3 Ethernet standards listed in Features and Benefits. Ethernet traffic is transmitted through the SFP28 / SFP56 / QSFP56 connector on the adapter card.

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

PCI Express Interface

ConnectX-6 Dx adapter cards support PCI Express Gen 3.0/4.0 (1.1 and 2.0 compatible) through x8/16 edge connectors. 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 4.0 and 3.0 compliant, 2.0 and 1.1 compatible
- 2.5, 5.0, 8.0, or 16.0 GT/s link rate x8 or x16 lanes
- Auto-negotiates to x16, x8, x4, x2, or x1
- Support for MSI/MSI-X mechanisms

Networking Ports LEDs Interface

For the networking ports LEDs description, follow the below table depending on the OPN you have purchased.

OPN	LEDs Scheme
MCX621102A[C/N/E]-ADAT, MCX621202A(C/S)-ADAT	Scheme 1: One Bi-Color LED
MCX623102A[C/N]-ADAT, MCX623102A[C/N]-GDAT, MCX623102A[S/E/N/C]-GDAT MCX623105A[N/E]-CDAT, MCX623106A[C/N/S/E]-CDAT, MCX623106P[C/N/E]-CDAT, MCX623105A[C/N/S/E]-VDAT	Scheme 2: One Bi-Color LED and one Single Color LED

Scheme 1: One Bi-Color LED

There is one bicolor (Yellow and Green) I/O LED per port to indicate speed and link status.

Link Indications

<table>
<tr><th>State</th><th>Bi-Color LED (Yellow/Green)
Physical link speed</th></tr>
<tr><td>Beacon command for locating the adapter card</td><td>1Hz blinking Yellow</td></tr>
<tr><td>Error</td><td>4Hz blinking Yellow Indicates an error with the link. The error can be one of the following:
<table>
<tr><th>Error Type</th><th>Description</th><th>LED Behavior</th></tr>
<tr><td>I^2C</td><td>I^2C access to the networking ports fails</td><td>Blinks until error is fixed</td></tr>
<tr><td>Over-current</td><td>Over-current condition of the networking ports</td><td>Blinks until error is fixed</td></tr>
</table></td></tr>
<tr><td>Physical Activity</td><td>The Green LED will blink.</td></tr>
<tr><td>Link Up</td><td>The Green LED will be solid.</td></tr>
</table>

Scheme 2: One Bi-Color LED and one Single Color LED

There are two I/O LEDs per port to indicate speed and link status. LED1 is a bicolor LED (Yellow and green) and LED2 is a single color LED (green).

Link Indications

<table>
<tr><th>State</th><th>Bi-Color LED (Yellow/Green)</th><th>Single Color LED (Green)</th></tr>
<tr><td>Beacon command for locating the adapter card</td><td>1Hz blinking Yellow</td><td>OFF</td></tr>
<tr><td>Error</td><td>4Hz blinking Yellow Indicates an error with the link. The error can be one of the following:
<table>
<tr><th>Error Type</th><th>Description</th><th>LED Behavior</th></tr>
<tr><td>I^2C</td><td>I^2C access to the networking ports fails</td><td>Blinks until error is fixed</td></tr>
<tr><td>Over-current</td><td>Over-current condition of the networking ports</td><td>Blinks until error is fixed</td></tr>
</table></td><td>ON</td></tr>
<tr><td>Physical Activity</td><td>The Green LED will blink.</td><td>Blinking</td></tr>
<tr><td>Link Up</td><td>The Green LED will be solid.</td><td>ON</td></tr>
</table>

SMBus Interface

ConnectX-6 Dx technology maintains support for manageability through a BMC. ConnectX-6 Dx 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 NVIDIA PCIe stand-up adapter. For configuring the adapter for the specific manageability solution in use by the server, please contact NVIDIA Support.

Voltage Regulators

The voltage regulator power is derived from the PCI Express edge connector 12V supply pins. These voltage supply pins feed on-board regulators that provide the necessary power to the various components on the card.

Heatsink

The heatsink is attached to the ConnectX-6 Dx IC in order to dissipate the heat. It is attached either by using four spring-loaded push pins that insert into four mounting holes, or by screws. ConnectX-6 Dx IC has a thermal shutdown safety mechanism that automatically shuts down the ConnectX-6 Dx card in cases of high-temperature event, improper thermal coupling or heatsink removal.

Thermal Sensors

Unable to render include or excerpt-include. Could not retrieve page.

Hardware Installation

Installation and initialization of ConnectX-6 Dx adapter cards require attention to the mechanical attributes, power specification, and precautions for electronic equipment.

Safety Warnings

Safety warnings are provided here in the English language. For safety warnings in other languages, refer to the Adapter Installation Safety Instructions.

Please observe all safety warnings to avoid injury and prevent damage to system components.

Unable to render include or excerpt-include. Could not retrieve page.

Installation Procedure Overview

The installation procedure of ConnectX-6 Dx adapter cards involves the following steps:

Step	Procedure	Direct Link
1	Check the system's hardware and software requirements.	Refer to System Requirements
2	Pay attention to the airflow consideration within the host system	Refer to Airflow Requirements
3	Follow the safety precautions	Refer to Safety Precautions
4	Unpack the package	Refer to Unpack the package
5	Follow the pre-installation checklist	Refer to Pre-Installation Checklist
6	(Optional) Replace the full-height mounting bracket with the supplied short bracket	Refer to Bracket Replacement Instructions
7	Install the ConnectX-6 Dx card in the system	Refer to Installation Instructions
8	Connect cables or modules to the card	Refer to Cables and Modules
9	Identify ConnectX-6 Dx in the system	Refer to Identifying Your Card

System Requirements

Hardware Requirements

> Unless otherwise specified, NVIDIA Hardware Installation Airflow Requirements 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 slot of the corresponding bus width is required for installing the card.

> For proper operation and performance, please make sure to use a PCIe slot with a corresponding bus width that can supply sufficient power to your card. Refer to the Specifications section of the manual for more power requirements.

Airflow Requirements

ConnectX-6 Dx adapter cards are offered with two airflow patterns: from the heatsink to the network ports.

Please refer to the Specifications section for airflow numbers for each specific card model.

> All cards in the system should be planned with the same airflow direction.

Software Requirements

- See Operating Systems/Distributions section under the Introduction section.
- Software Stacks - NVIDIA OpenFabric software package MLNX_OFED for Linux, WinOF-2 for Windows, and VMware. See the Driver Installation section.

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.

- Remove any metallic objects from your hands and wrists.
- Make sure to use only insulated tools.

- Verify that the system is powered off and is unplugged.
- It is strongly recommended to use an ESD strap or other antistatic devices.

Unpacking the Package

Check against the package contents list that all the parts have been sent. Check the parts for visible damage that may have occurred during shipping. Please note that the cards must be placed on an antistatic surface.

Category	Qty.	Item
Cards	1	ConnectX-6 Dx adapter card
Accessories	1	Adapter card short bracket
	1	Adapter card tall bracket (shipped assembled on the card)

Please note that if the card is removed hastily from the antistatic bag, the plastic ziplock may harm the EMI fingers on the networking connector. Carefully remove the card from the antistatic bag to avoid damaging the EMI fingers.

Pre-Installation Checklist

1. Verify that your system meets the hardware and software requirements stated above.
2. Shut down your system if active.
   Turn off the power to the system, and disconnect the power cord. Refer to the system documentation for instructions.

3. (Optional) Check the mounting bracket on the card.
   If required for your system, replace the full-height mounting bracket that is shipped mounted on the card with the supplied low-profile bracket. Refer to Bracket Replacement Instructions.

Bracket Replacement Instructions

The ConnectX-6 Dx card is usually shipped with an assembled high-profile bracket. If this form factor is suitable for your requirements, you can skip the remainder of this section and move to Installation Instructions. If you need to replace the high-profile bracket 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 bracket

Removing the Existing Bracket

1. Using a torque driver, remove the two screws holding the bracket in place.
2. Separate the bracket from the ConnectX-6 Dx card.

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

3. Save the two screws.

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.

2. Screw on the bracket using the screws saved from the bracket removal procedure above.

   > Use a torque driver to apply up to 2 lbs-in torque on the screws.

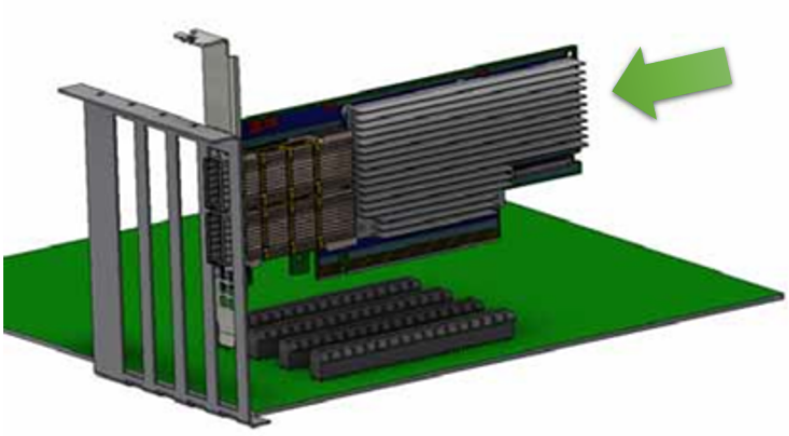
Installation Instructions

This section provides detailed instructions on how to install your adapter card in a system.

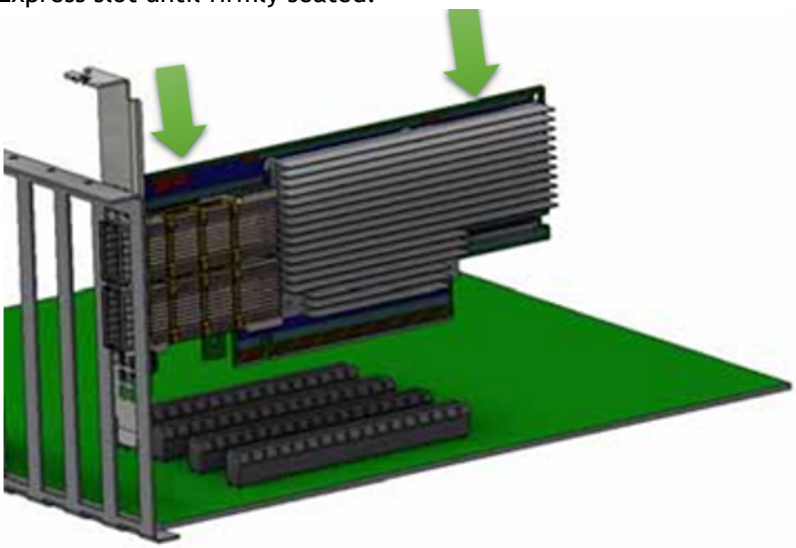
> Please note that the following figures are for illustration purposes only.

➢ Connect the adapter Card in an available PCI Express slot in the chassis.

Step 1: Locate an available PCI Express slot and insert the adapter card to the chassis.



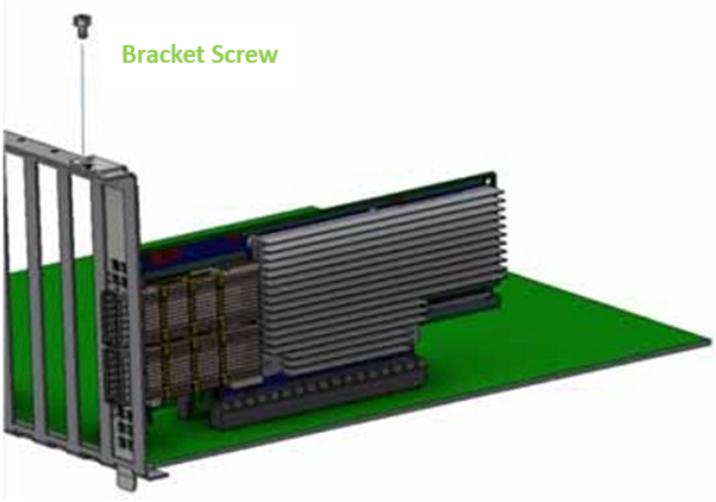
Step 2: Applying even pressure at both corners of the card, insert the adapter card in a PCI Express slot until firmly seated.



Do not use excessive force when seating the card, as this may damage the chassis.

➢ Secure the adapter card to the chassis.

Step 1: Secure the bracket to the chassis with the bracket screw.



To uninstall the adapter card, see Uninstalling the Card.

Cables and Modules

To obtain the list of supported Mellanox cables for your adapter, please refer to the Cables Reference Table at Networking Configuration Tools.

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 Green 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 LED Interface under the Interfaces section.

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 LED Interface under the Interfaces section.
5. Care should be taken as not to impede the air exhaust flow through the ventilation holes. Use cable lengths that 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. The LED indicator will turn off when the cable is unseated.

Identifying the Card in Your System

On Linux

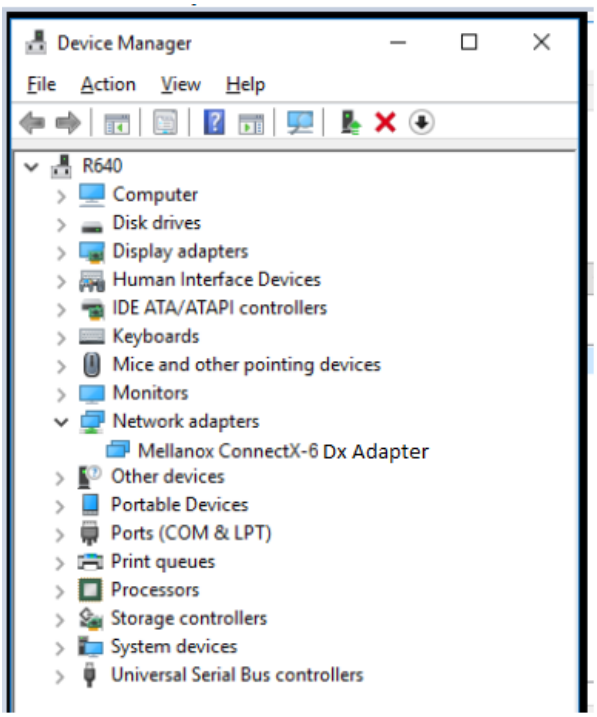
Get the device location on the PCI bus by running lspci and locating lines with the string “Mellanox Technologies”:

```
lspci |grep -i Mellanox
Network controller: Mellanox Technologies MT2892 Family [ConnectX-6 Dx]
```

On Windows

1. Open Device Manager on the server. Click Start => Run, and then enter devmgmt.msc.
2. Expand System Devices and locate your ConnectX-6 Dx 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 Property pull-down menu.

   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 NVIDIA; and DEV is equal to 1018 (for ConnectX-6 Dx) – this is a valid NVIDIA PCI Device ID.

   ⚠ If the PCI device does not have an NVIDIA adapter ID, return to Step 2 to check another device.

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

Uninstalling the Card

Safety Precautions

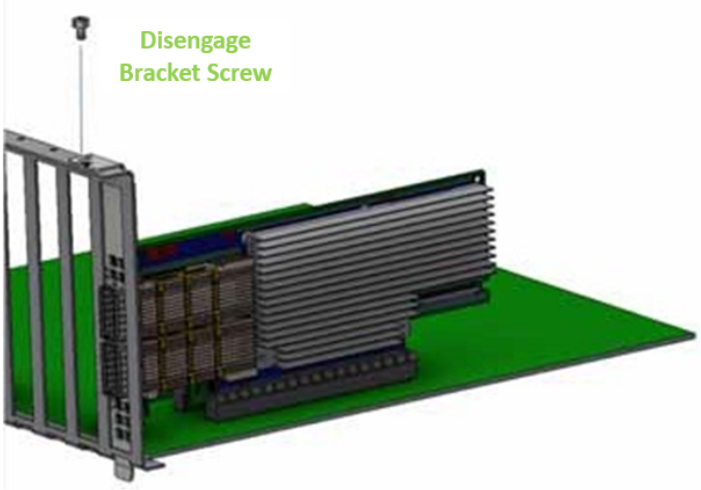
The adapter is installed in a system that operates with voltages that can be lethal. Before uninstalling the adapter card, please observe the following precautions to avoid injury and prevent damage to system components.

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.

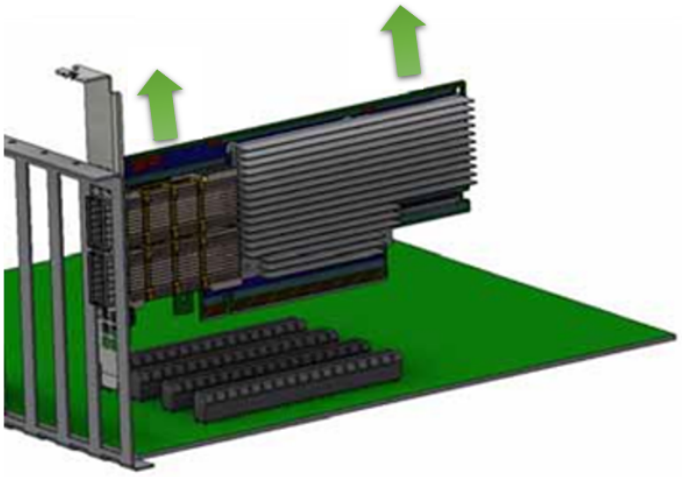
Card Removal

ⓘ 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 ConnectX-6 and Auxiliary Connections cards out of the PCI Express slot.



Driver Installation

Please use the relevant driver installation section.

- Linux Driver Installation
- Windows Driver Installation
- VMware Driver Installation

Linux Driver Installation

This section describes how to install and test the MLNX_OFED for Linux package on a single server with a ConnectX-6 Dx adapter card installed.

Prerequisites

Requirements	Description
Platforms	A server platform with a ConnectX-6 Dx Ethernet adapter card installed.
Required Disk Space for Installation	1GB
Operating System	Linux operating system. For the list of supported operating system distributions and kernels, please refer to the *MLNX_OFED Release Notes* file.
Installer Privileges	The installation requires administrator (root) privileges on the target machine.

Downloading MLNX_OFED

1. Verify that the system has a network adapter installed by running lspci command. The below table provides output examples per ConnectX-6 Dx card configuration.

```
# lspci -v | grep Mellanox
86:00.0 Network controller [0207]: Mellanox Technologies MT28908A0 Family
Subsystem: Mellanox Technologies Device 0014
86:00.1 Network controller [0207]: Mellanox Technologies MT28908A0 Family
Subsystem: Mellanox Technologies Device 0014
```

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 and install the latest OpenFabrics Enterprise Distribution (OFED) software package available via the NVIDIA web site at https://www.nvidia.com/en-us/networking/products/software/ > InfiniBand Drivers > Learn More > NVIDIA MLNX_OFED
   a. Scroll down to the Download wizard, and click the Download tab.
   b. Choose your relevant package depending on your host operating system.
   c. Click the desired ISO/tgz package.
   d. To obtain the download link, accept the End User License Agreement (EULA).

3. Use the Hash 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.

```
SHA256 MLNX_OFED_LINUX-<ver>-<OS label>.iso
```

Installing MLNX_OFED

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 upgrades the firmware.
  Note: The firmware will not be updated if you run the install script with the '--without-fw-update' option.
  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]
```

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

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

- If you need to install MLNX_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 NVIDIA, 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, MLNX_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.

Installation Procedure

1. Login to the installation machine as root.
2. Mount the ISO image on your machine.

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

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 NVIDIA, 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 NVIDIA 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 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-6 Dx
Part Number:      MCX623106AC-CDAT

Description:      ConnectX®-6 Dx EN adapter card, 100GbE, Dual-port QSFP56, PCIe 4.0 x16, Crypto and Secure Boot, Tall Bracket


PCI Device Name: 0b:00.0
Base MAC: 0000e41d2d5cf810
Versions: Current Available
FW 28.33.0800     28.33.1000
Status: Up to date
```

In case 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-6 Dx
Part Number:      MCX623106AC-CDAT

Description:      ConnectX®-6 Dx EN adapter card, 100GbE, Dual-port QSFP56, PCIe 4.0 x16,
Crypto and Secure Boot, Tall Bracket


PCI Device Name: 0b:00.0
Base MAC: 0000e41d2d5cf810
Versions: Current Available
FW 28.33.0800     28.33.1000

Status:           No matching image found
```

Error message 2:

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

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-6 Dx Socket Direct - perform a cold reboot (power cycle)
   Otherwise, restart the driver by running: `/etc/init.d/openibd restart`

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

Most of the MLNX_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.

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 Red Hat 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 MLNX_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.
	`The firmware for this device is not distributed inside NVIDIA driver: 0000:01:00.0 (PSID: IBM2150110033)`
	`To obtain firmware for this device, please contact your HW vendor.`

Installation Logs

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>.<PD>.logs`".

Example:

```
Logs dir: /tmp/MLNX_OFED_LINUX-4.4-1.0.0.0.63414.logs
```

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.

Driver Load Upon System Boot

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

To prevent automatic load of the NVIDIA drivers upon system boot:

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
```

2. Set “ONBOOT=no” in the "/etc/infiniband/openib.conf" file.
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.

mlnxofedinstall Return Codes

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

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

Uninstalling MLNX_OFED

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

Installing MLNX_OFED Using YUM

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

Setting up MLNX_OFED YUM Repository

1. Log into the installation machine as root.
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
```

3. Download and install 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]
```

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]:
```

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>)
```

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
```

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 subscription-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
```

Installing MLNX_OFED Using the YUM Tool

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

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.x8
6_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.fc2
1.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.fc2
1.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.x8
6_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-
01.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.x8
6_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.

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 package:
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!
```

Uninstalling MLNX_OFED Using the YUM Tool

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

Installing MLNX_OFED Using apt-get Tool

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

Setting up MLNX_OFED apt-get Repository

1. Log into the installation machine as root.
2. Extract the MLNX_OFED package on a shared location in your network.
   You can download it from https://www.nvidia.com/en-us/networking/products/software/ > InfiniBand Drivers > Learn More > NVIDIA MLNX_OFED
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 ./
```

4. Download and install GPG-KEY.

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

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
```

6. Update the apt-get cache.

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

Installing MLNX_OFED Using the apt-get Tool

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

1. View the available package groups by invoking:

```
<pre># 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.
```

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 NVIDIA's website as described in Updating Adapter Firmware.

Uninstalling MLNX_OFED Using the apt-get Tool

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

Updating Firmware After Installation

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

Updating the Device Online

To update the device online on the machine from the NVIDIA 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-6 Dx
Part Number:      MCX623106AC-CDAT
Description:      ConnectX®-6 Dx EN adapter card, 100GbE, Dual-port QSFP56, PCIe 4.0 x16, Crypto and Secure Boot,
Tall Bracket    PCI Device Name: 0b:00.0
Base MAC:         0000e41d2d5cf810
Versions:         Current         Available
  FW              28.33.0800      28.33.1000
  Status:           Update required
---------
Found 1 device(s) requiring firmware update. Please use -u flag to perform the update.
```

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 NVIDIA website (http://www.nvidia.com > Support > Firmware Download).

1. Get the device's PSID.

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

2. Download the firmware BIN file from the NVIDIA website or the OEM website.

3. Burn the firmware.

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

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

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"
```

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.

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 that (1) The 'mokutil' package is installed on your system, and (2) The system is booted in UEFI mode.

1. Download the x.509 public key.

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

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

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

3. Reboot the system.

The pending MOK key enrollment request will be noticed by shim.efi and it will launch MokManager.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#

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. 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:

1. Remove the signature.

```
# rpm -qa | grep -E "kernel-ib|mlnx-ofa_kernel|iser|srp|knem|mlnx-rds|mlnx-nfsrdma|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 - tainting kernel"
```

This message is only presented once, upon first module boot that either has no signature or whose key is not in the kernel key ring. Therefore, this message may go unnoticed. Once the system is rebooted after unloading and reloading a kernel module, the message will appear. (Note that this message cannot be eliminated.)

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

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

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 NVIDIA Network Adapters.

Windows Driver Installation

For Windows, download and install the latest WinOF-2 for Windows software package available via the NVIDIA website at: https://www.nvidia.com/en-us/networking/products/software/ > InfiniBand Drivers > Learn More > NVIDIA WinOF-2. Follow the installation instructions included in the download package (also available from the download page).

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

Software Requirements

Description	Package
Windows Server 2022	MLNX_WinOF2-<version>_All_x64.exe
Windows Server 2019	
Windows Server 2016	
Windows Server 2012 R2	
Windows 11 Client (64 bit only)	
Windows 10 Client (64 bit only)	
Windows 8.1 Client (64 bit only)	

Note: The Operating System listed above must run with administrator privileges.

Downloading WinOF-2 Driver

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

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

```
echo %PROCESSOR_ARCHITECTURE%
```

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

2. Go to the WinOF-2 web page at: https://www.nvidia.com/en-us/networking/products/software/ InfiniBand Drivers → NVIDIA WinOF-2
3. Download the .exe image according to the architecture of your machine (see Step 1).
   The name of the .exe is in the following format: MLNX_WinOF2-<version>_<arch>.exe.

   ⚠ Installing the incorrect .exe file is prohibited. If you do so, an error message will be displayed.
   For example, if you 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”

Installing WinOF-2 Driver

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

This section provides instructions for two types of installation procedures, and both require administrator privileges:

- 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.

Attended Installation

The following is an example of an installation session.

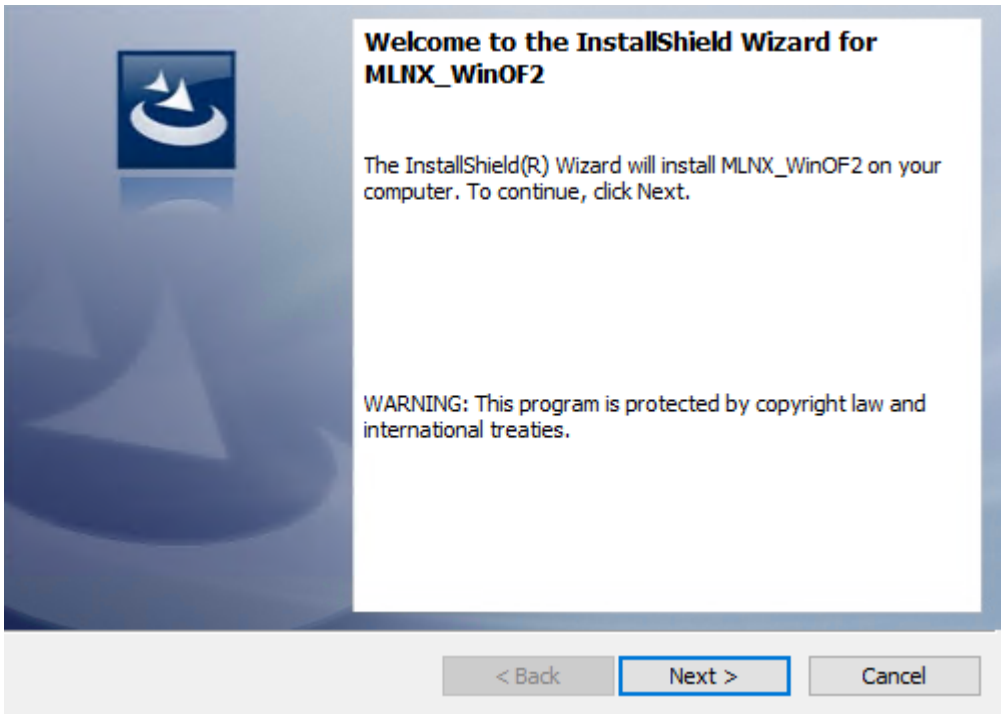
1. Double click the .exe and follow the GUI instructions to install MLNX_WinOF2.
2. [Optional] Manually configure your setup to contain the logs option (replace “LogFile” with the relevant directory):

```
MLNX_WinOF2_<revision_version>_All_Arch.exe /v"/l*vx [LogFile]"
```

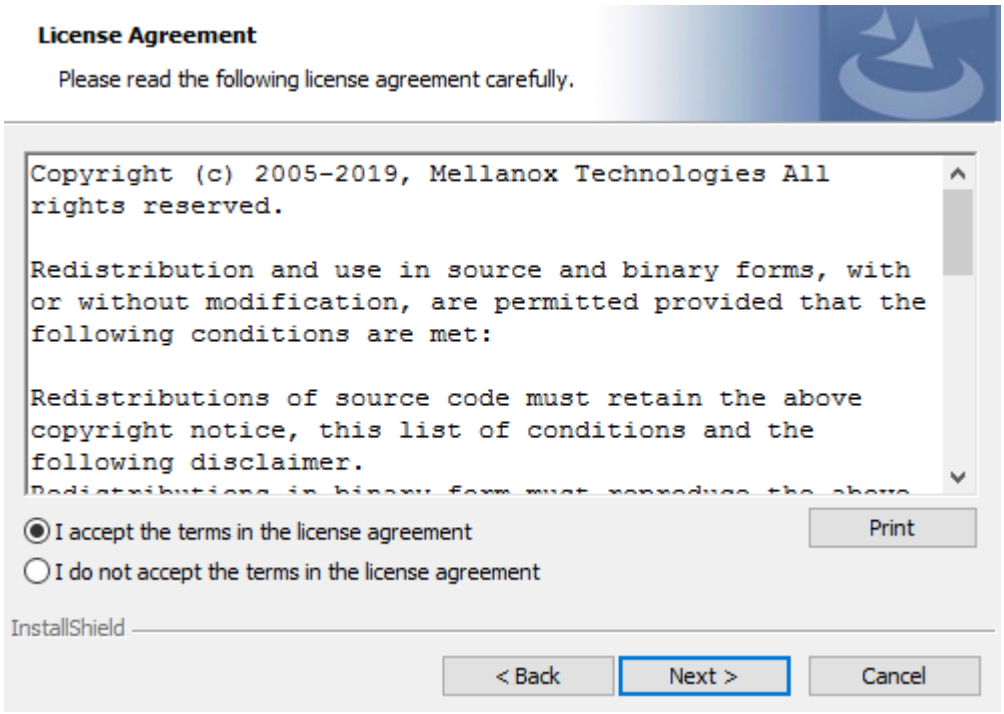
3. [Optional] If you do not want to upgrade your firmware version. (Note: MT_SKIPFWUPGRD default value is False.)

```
MLNX_WinOF2_<revision_version>_All_Arch.exe /v" MT_SKIPFWUPGRD=1"
```

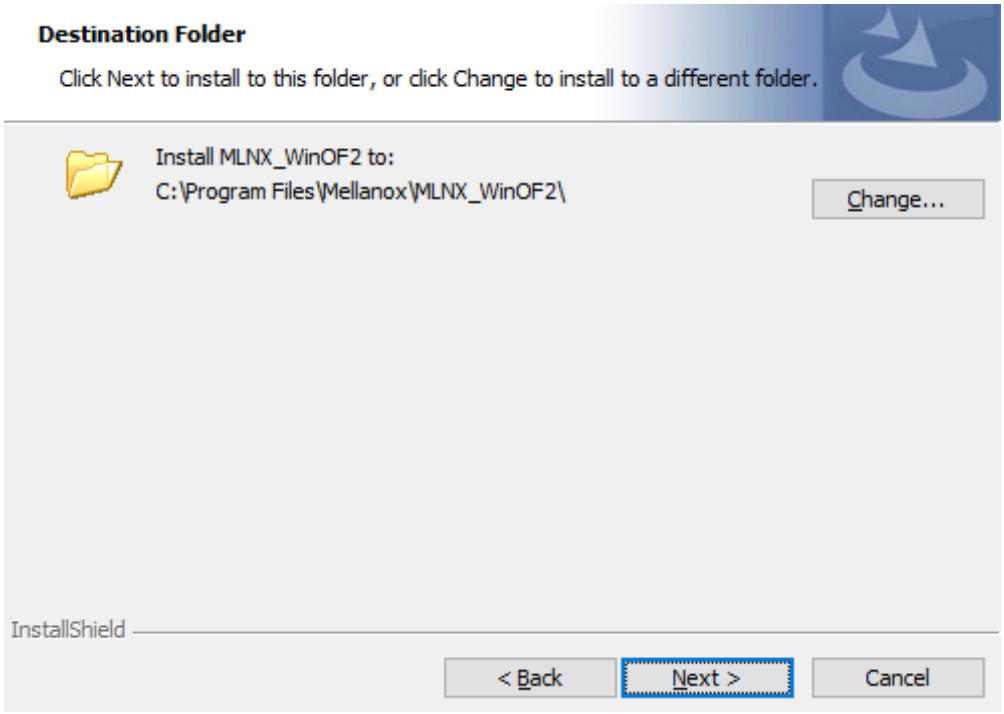
4. Click Next in the Welcome screen.



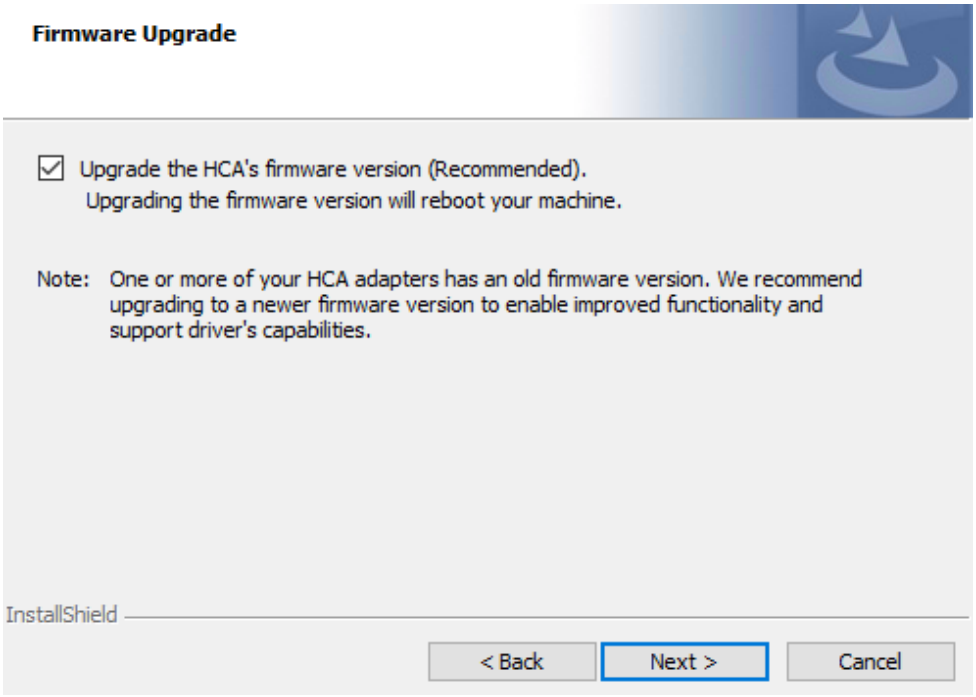
5. Read and accept the license agreement and click Next.



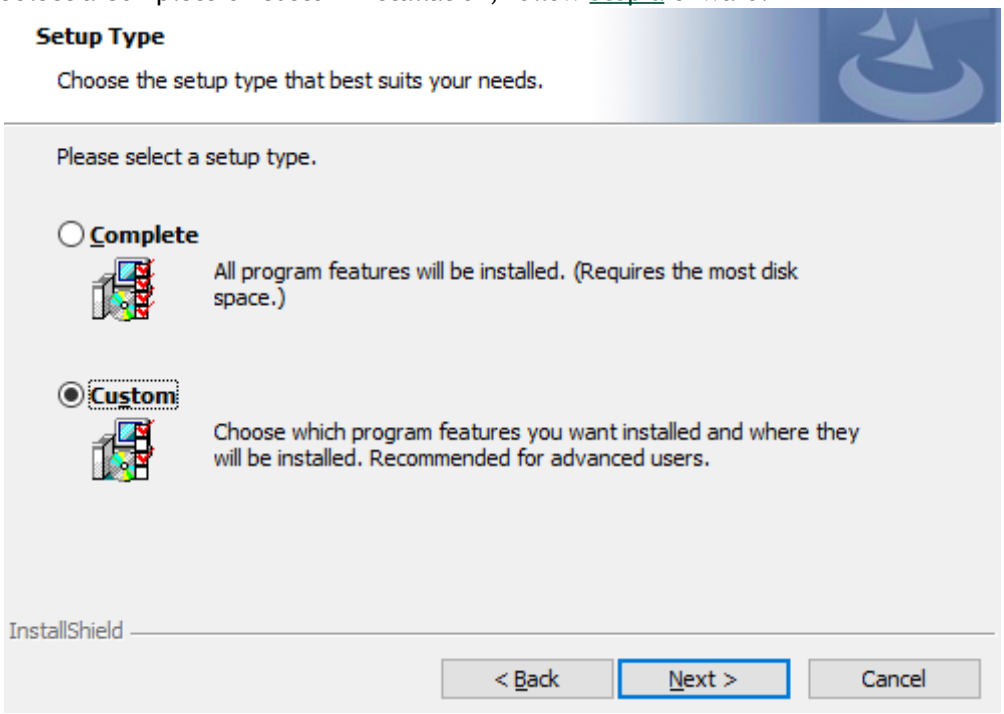
6. Select the target folder for the installation.



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 adapter card with an older firmware version, the firmware will be updated accordingly. However, if the user has both an OEM card and an NVIDIA adapter card, only the NVIDIA card will be updated.



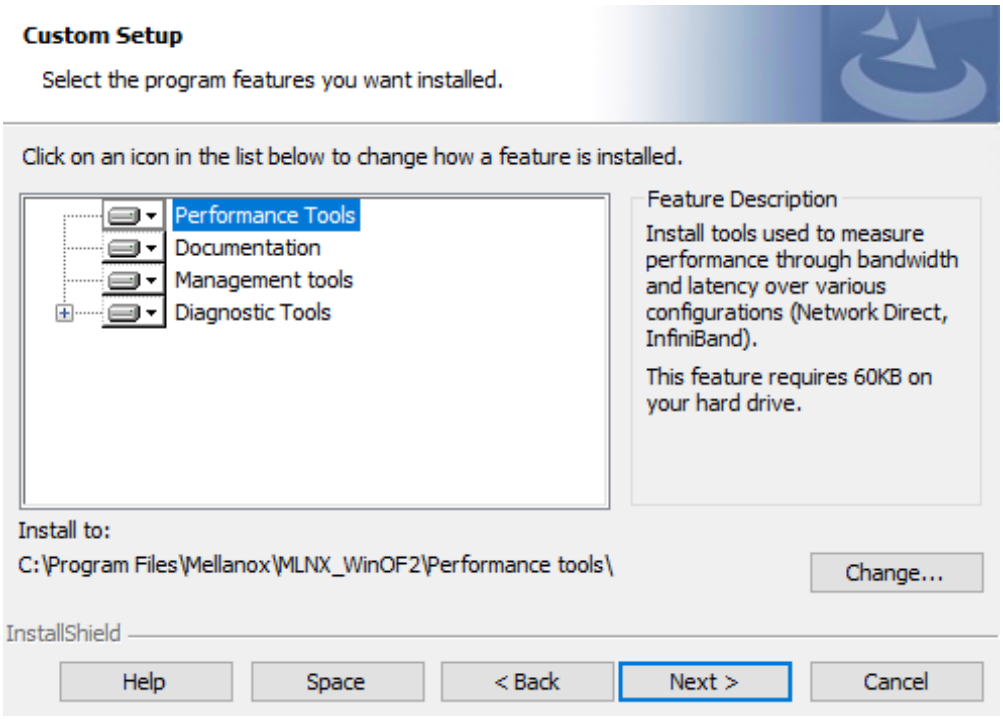
8. Select a Complete or Custom installation, follow Step a onward.



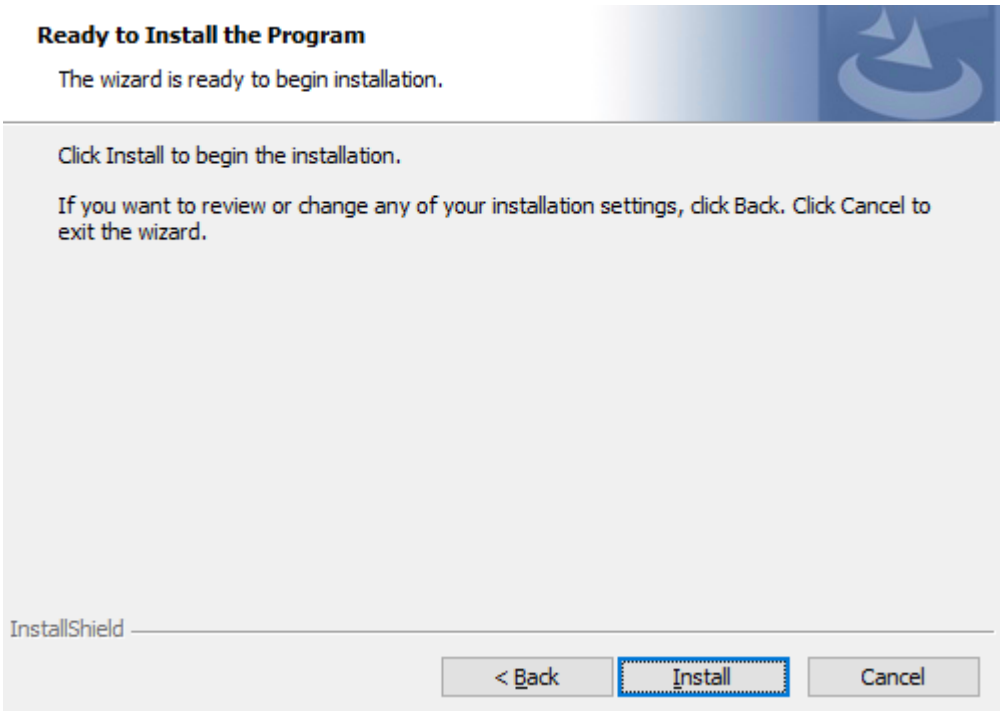
a. Select the desired feature to install:
   - Performances tools - install the performance tools that are used to measure performance in user environment
   - Documentation - contains the User Manual and Release Notes
   - Management tools - installation tools used for management, such as mlxstat

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

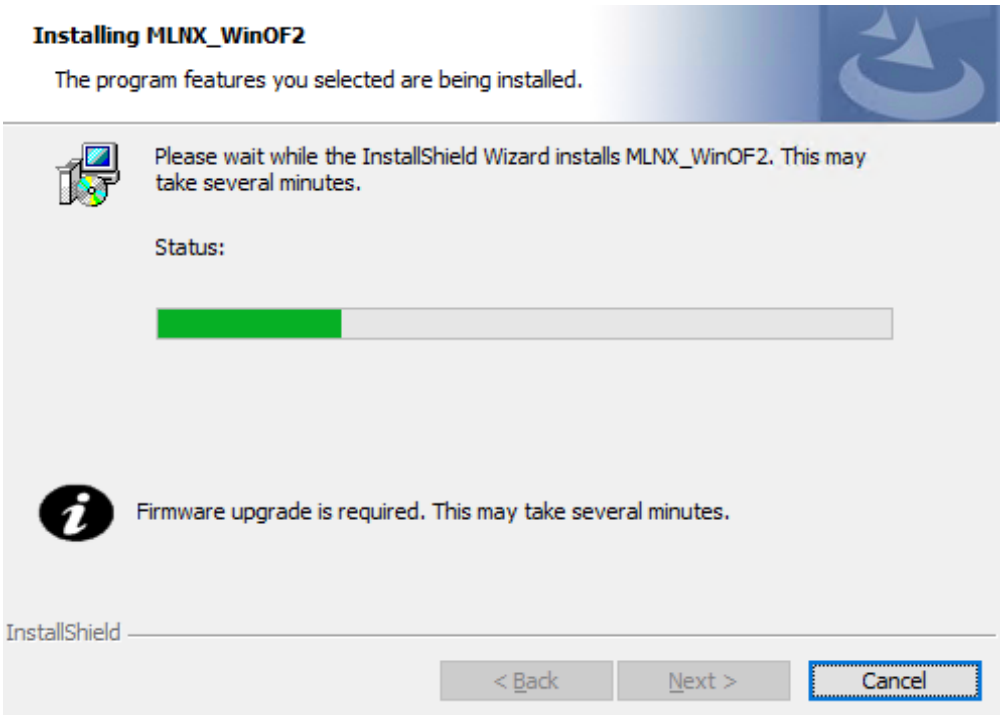
b. Click Next to install the desired tools.



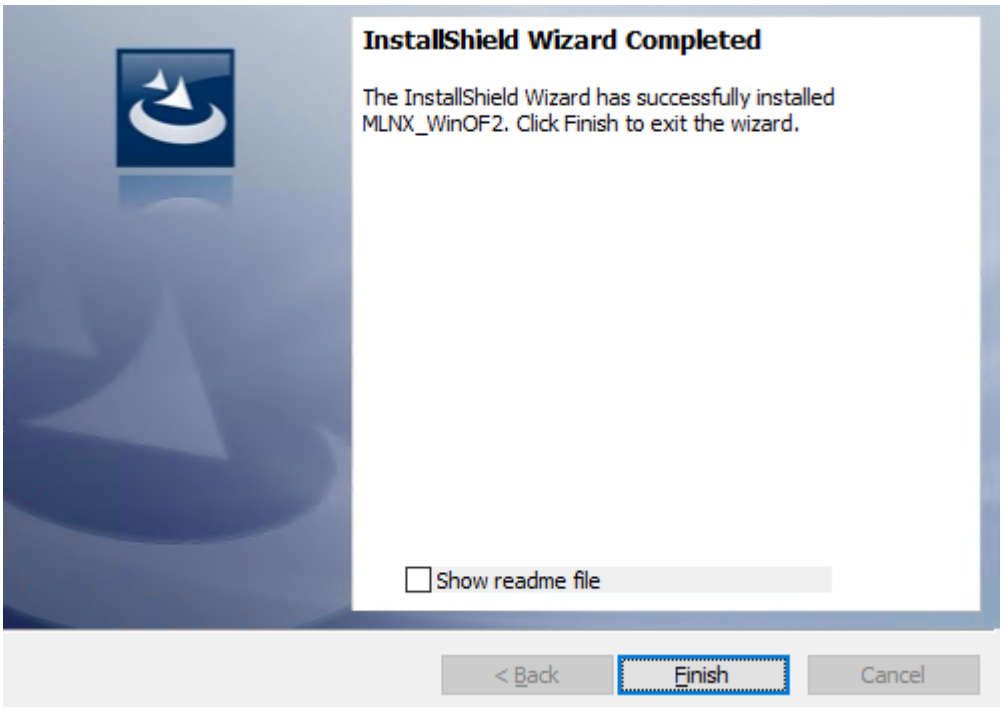
9. Click Install to start the installation.



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



11. Click Finish to complete the installation.



1

Unattended Installation

> If no reboot options are specified, the installer restarts the computer whenever necessary without displaying any prompt or warning to the user.
> To control the reboots, use the */norestart* or */forcerestart* standard command-line options.

The following is an example of an unattended installation session.

1. Open a CMD console-> Click Start-> Task Manager File-> Run new task-> and enter CMD.
2. Install the driver. Run:

```
MLNX_WinOF2-[Driver/Version]_<revision_version>_All_Arch.exe /S /v/qn
```

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

```
MLNX_WinOF2-[Driver/Version]_<revision_version>_All_-Arch.exe /S /v/qn /v"/l*vx [LogFile]"
```

4. [Optional] if you wish to control whether to install ND provider or not (i.e., *MT_NDPROPERTY default value is True*).

```
MLNX_WinOF2-[Driver/Version]_<revision_version>_All_Arch.exe /vMT_NDPROPERTY=1
```

5. [Optional] If you do not wish to upgrade your firmware version (i.e.,*MT_SKIPFWUPGRD default value is False*).

```
MLNX_WinOF2-[Driver/Version]_<revision_version>_All_Arch.exe /vMT_SKIPFWUPGRD=1
```

6. [Optional] If you want to enable the default configuration for Rivermax, run.

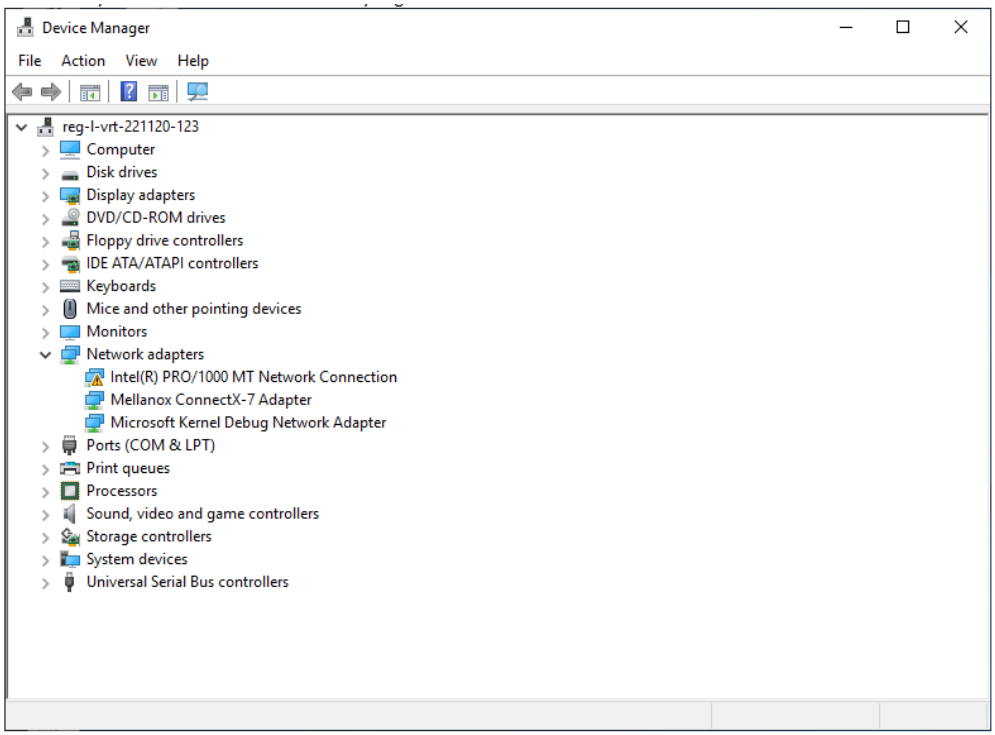
```
MLNX_WinOF2_<revision_version>_All_Arch.exe /v"MT_RIVERMAX=1 /l*vx C:\Users\<user>\log.txt "
```

Installation Results

Upon installation completion, you can verify the successful addition of the network card(s) through the Device Manager. The inf files can be located at:

```
%ProgramFiles%\Mellanox\MLNX_WinOF2\Drivers\
```

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



Uninstalling WinOF-2 Driver

Attended Uninstallation

To uninstall MLNX_WinOF2 on a single node:

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

Unattended Uninstallation

To uninstall MLNX_WinOF2 in unattended mode:

1. Open a CMD console. (Click Task Manager > File > Run new task, and enter CMD.)
2. To uninstall the driver, run:

```
MLNX_WinOF2-<version>_All_x64.exe /S /x /v"/qn"
```

Extracting Files Without Running Installation

➢ *To extract the files without running installation, perform the following steps:*

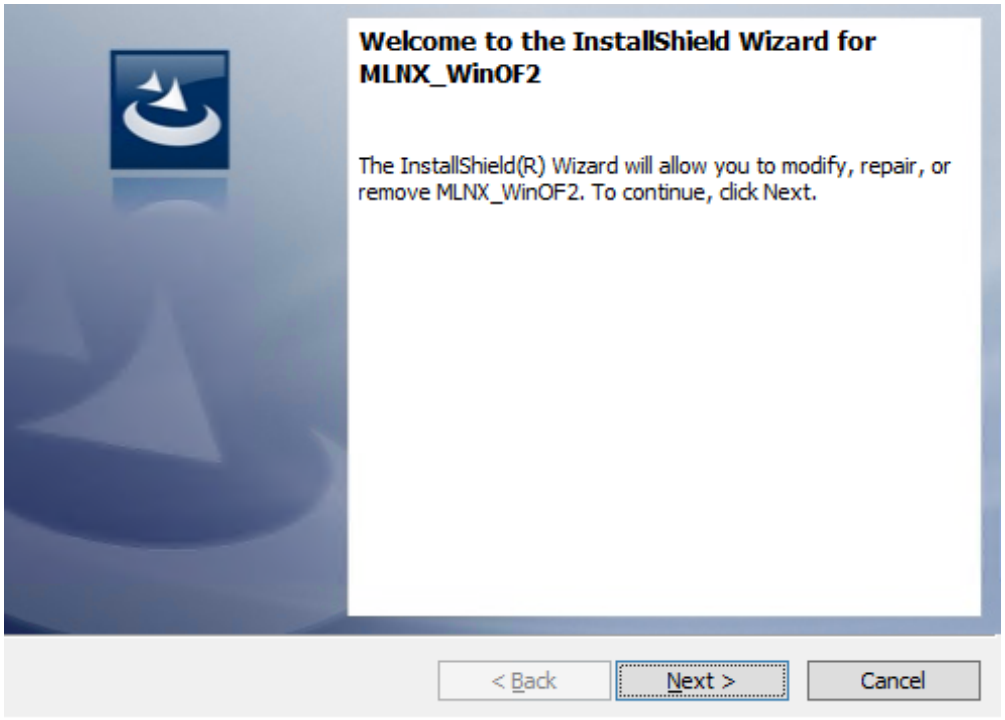
1. Open a CMD console-> Click Start-> Task Manager-> File-> Run new task-> and enter CMD.
2. Extract the driver and the tools:

```
MLNX_WinOF2-<revision_version>_All_x64 /a
```

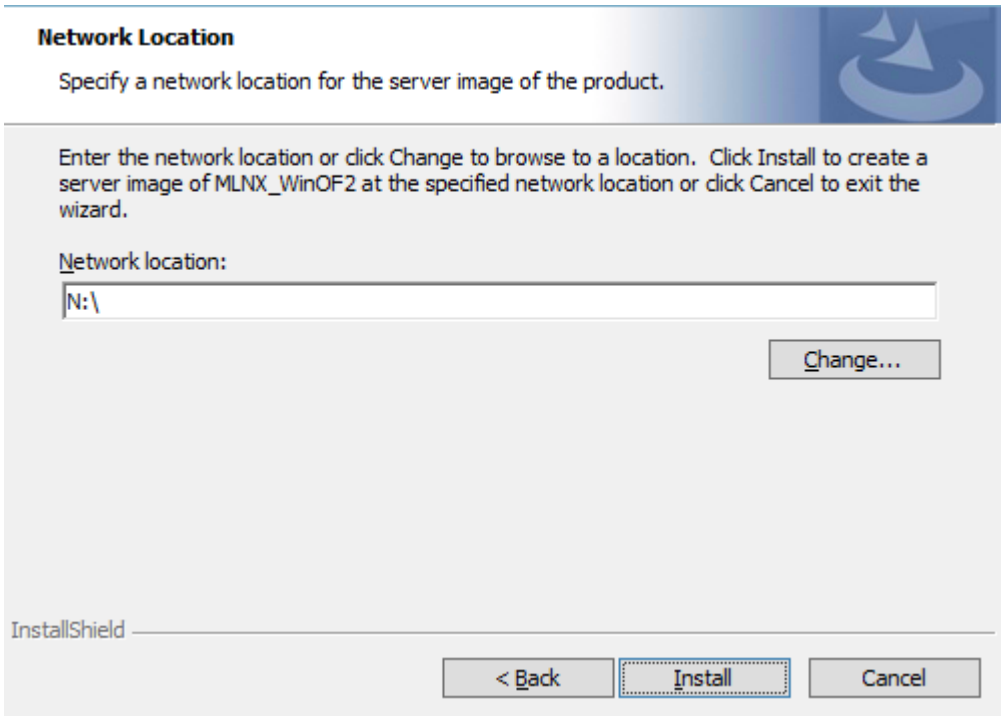
   To extract only the driver file:

```
MLNX_WinOF2-<revision_version>_All_x64 /a /vMT_DRIVERS_ONLY=1
```

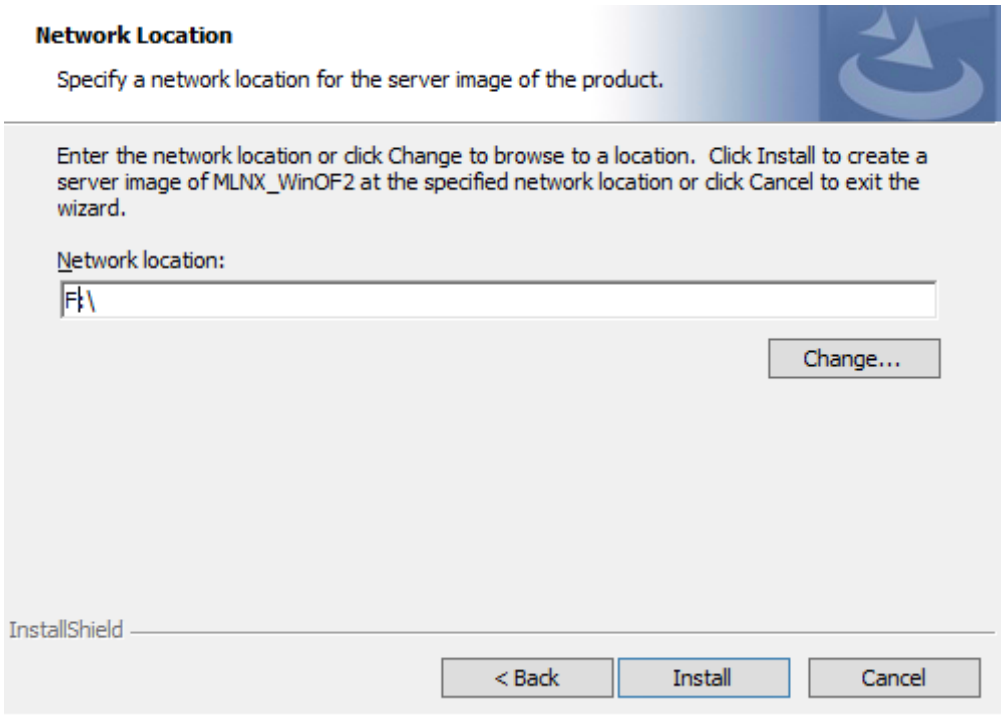
3. Click Next to create a server image.



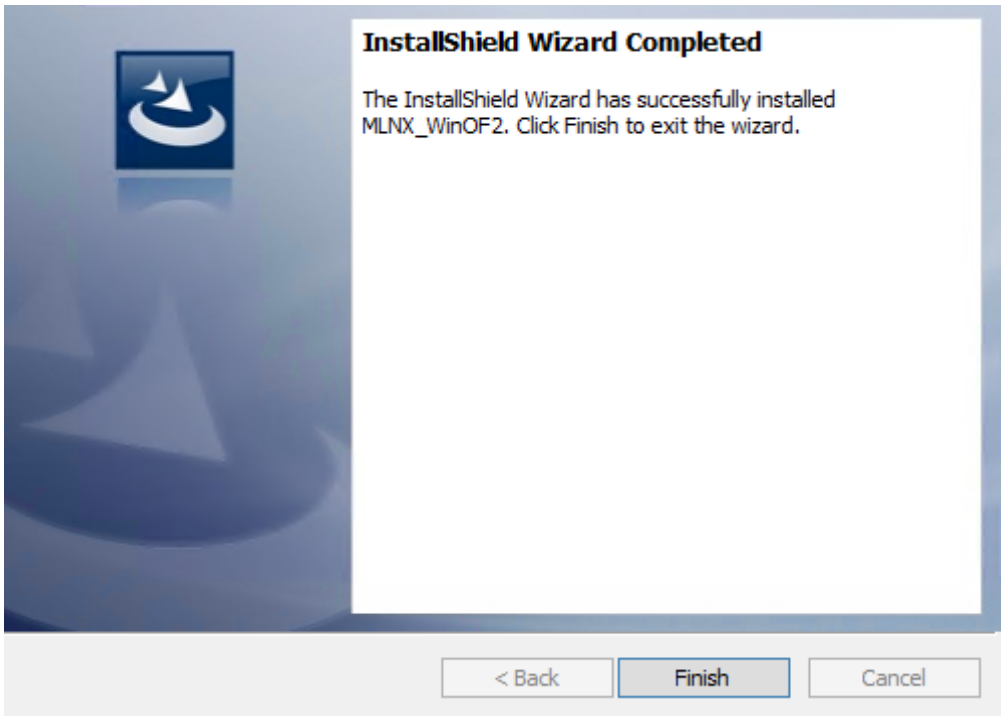
4. Click Change and specify the location in which the files are extracted to.



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



6. To complete the extraction, click Finish.



Firmware Upgrade

If the machine has a standard adapter 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 the MFT User Manual.

VMware Driver Installation

This section describes VMware Driver Installation.

Hardware and Software Requirements

Requirement	Description
Platforms	A server platform with an adapter card based on NVIDIA devices: • ConnectX®-6 Dx (EN) (firmware: fw-ConnectX6Dx)
Operating System	ESXi 8.x
Installer Privileges	The installation requires administrator privileges on the target machine.

Installing NATIVE ESXi Driver for VMware vSphere

> ⚠ Please uninstall all previous driver packages prior to installing the new version.

To install the driver:

1. Log into the ESXi server with root permissions.
2. Install the driver.

   ```
   #> esxcli software vib install -d <path>/<bundle_file>
   ```

   Example:

   ```
   #> esxcli software vib install -d /tmp/MLNX-NATIVE-ESX-ConnectX-4-5_4.16.8.8-10EM-650.0.0.4240417.zipesxcli
   ```

3. Reboot the machine.
4. Verify the driver was installed successfully.

   ```
   esxcli software vib list | grep nmlx
   nmlx5-core      4.16.8.8-1OEM.650.0.0.4240417    MEL    PartnerSupported 2017-01-31
   nmlx5-rdma      4.16.8.8-1OEM.650.0.0.4240417    MEL    PartnerSupported 2017-01-31
   ```

> ⚠ After the installation process, all kernel modules are loaded automatically upon boot.

Removing Earlier NVIDIA Drivers

> ⚠ Please unload the previously installed drivers before removing them.

To remove all the drivers:

1. Log into the ESXi server with root permissions.
2. List all the existing NATIVE ESXi driver modules. (See Step 4 in Installing NATIVE ESXi Driver for VMware vSphere.)
3. Remove each module:

   ```
   #> esxcli software vib remove -n nmlx5-rdma
   #> esxcli software vib remove -n nmlx5-core
   ```

   > ⚠ To remove the modules, you must run the command in the same order as shown in the example above.

4. Reboot the server.

Firmware Programming

a. Download the VMware bootable binary images v4.6.0 from the Firmware Tools (MFT) site.
   i. ESXi 6.5 File: mft-4.6.0.48-10EM-650.0.0.4598673.x86_64.vib
   ii. MD5SUM: 0804cffe30913a7b4017445a0f0adbe1
b. Install the image according to the steps described in the MFT User Manual.

> ⚠ The following procedure requires custom boot image downloading, mounting and booting from a USB device.

Updating Adapter Firmware

Each adapter card is shipped with the latest version of qualified firmware at the time of manufacturing. However, NVIDIA 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 NVIDIA 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 at Update and Query Utility.

Firmware Update Example

```
[server1]# ./mlxup
Querying Mellanox devices firmware ...
Device Type:      ConnectX-6 Dx
Part Number:      MCX623105AN-VDAT
Description:      ConnectX®-6 Dx EN adapter card, 200GbE , Single-port QSFP56, PCIe 4.0 x16, No Crypto, Tall Bracket
PSID:             MT_2190110032
PCI Device Name: 0000:06:00.0
Base GUID:        e41d2d0300fd8b8a
Versions:         Current            Available
                  FW 16.23.1020      16.24.1000

Status:           Update required

Device Type:      ConnectX-6 Dx
Part Number:      MCX623105AN-VDAT
Description:      ConnectX®-6 Dx EN adapter card, 200GbE , Single-port QSFP56, PCIe 4.0 x16, No Crypto, Tall Bracket
PSID:             MT_2170110021
PCI Device Name: 0000:07:00.0
Base MAC:         0000e41d2da206d4
Versions:         Current          Available
                  FW 16.24.1000    16.24.1000

Status:           Up to date

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
```

Troubleshooting

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
Event message received of insufficient power	• When [adapter's current power consumption] > [PCIe slot advertised power limit] - a warning message appears in the server's system even logs (Eg. dmesg: "Detected insufficient power on the PCIe slow") • It's recommended to use a PCIe slot that can supply enough power. • If a message of the following format appears - "mlx5_core 0003:01:00.0: port_module:254:(pid 0): Port module event[error]: module 0, Cable error, One or more network ports have been powered down due to insufficient/unadvertised power on the PCIe slot" please upgrade your Adapter's firmware. • If the message remains - please consider switching from Active Optical Cable (AOC) or transceiver to Direct Attached Copper (DAC) connectivity.

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
NVIDIA Firmware Tool (MFT)	Download and install MFT: http://www.nvidia.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.nvidia.com/supportdownloader
Collect Log File	cat /var/log/messages dmesg >> system.log journalctl (Applicable on new operating systems) cat /var/log/syslog

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.
NVIDIA Firmware Tool (MFT)	Download and install MFT: http://www.nvidia.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.nvidia.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

Specifications

MCX621102AC-ADAT / MCX621102AN-ADAT / MCX621102AN-ADAT Specifications

Physical	**Size**: 4.89in. x 2.71in (124.22mm x 68.90mm)			
	Connector: Dual SFP28 Ethernet (copper and optical)			
Protocol Support	**Data Rate:**	Ethernet	1/10/25 Gb/s	
	Ethernet: 25GBASE-R, 20GBASE-KR2, 10GBASE-LR,10GBASE-ER, 10GBASE-CX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR			
	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 8 lanes (2.0 and 1.1 compatible)			
Power Specifications[a]	**Voltage**: 12V			
	Power	**Cable**	**PCIe Gen 3.0**	**PCIe Gen 4.0**
	Typical Power[b]	Passive Cables	10.88W	11.29W
	Maximum Power	Passive Cables	15.55W	15.96W
	Maximum power available through SFP28 port: 1.5W (per port)			
	Voltage: 3.3Aux **Maximum current:** 100mA			
Environmental	**Temperature**	Operational	0°C to 55°C	
		Non-operational	-40°C to 70°C	
	Humidity	90% relative humidity[c]		
	Altitude (Operational)	3050m		
	Airflow Requirements @ 55C[d][e]	**Cable Type**	**Hot Aisle - Heatsink to Port**	
		Passive Cable	200LFM	
		Active 0.8W Cable	400 LFM	
		Active 1.5W Cable	450LFM	
Regulatory	**Safety**	CB / cTUVus / CE		
	EMC	CE / FCC / VCCI / ICES / RCM		
	RoHS	RoHS compliant		

a. Power numbers are provided for passive cables only. For board power numbers while using active cables, please add the outcome of the following formula to the passive cables power numbers stated above: *Active_Module_Power* x N*umber_of_Modules* x 1.1 (efficiency factor)
b. Typical power for ATIS traffic load.
c. For both operational and non-operational states.
d. Airflow is measured in wind tunnel.
e. Contact NVIDIA for airflow numbers with other active modules' power levels.

MCX623102AC-ADAT / MCX623102AN-ADAT / MCX623102AS-ADAT Specifications

Physical	**Size**: 5.59in. x 2.71in (142.00mm x 68.90mm)			
	Connector: Dual SFP28 Ethernet (copper and optical)			
Protocol Support	**Data Rate**:	Ethernet	1/10/25 Gb/s	
	Ethernet: 25GBASE-R, 20GBASE-KR2, 10GBASE-LR,10GBASE-ER, 10GBASE-CX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR			
	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)			
Power Specifications[a]	**Voltage**: 12V			
	Power	**Cable Type**	**PCIe Gen 3.0**	**PCIe Gen 4.0**
	Typical Power[b]	Passive Cables	14.87W	15.68W
	Maximum Power	Passive Cables	18.92W	19.74W
	Maximum power available through SFP28 port: 2.5W (each port)			
	Voltage: 3.3Aux **Maximum current**: 100mA			
Environmental	**Temperature**	Operational	0°C to 55°C	
		Non-operational	-40°C to 70°C	
	Humidity	90% relative humidity[c]		
	Altitude (Operational)	3050m		
	Airflow Requirements @ 55C[d][e]	**Cable Type**	**Hot Aisle - Heatsink to Port**	
		Passive Cable	300LFM	
		Active 0.8 Cable	400LFM	
		Active 2.5W Cable	500LFM	
Regulatory	**Safety**	CB / cTUVus / CE		
	EMC	CE / FCC / VCCI / ICES / RCM		
	RoHS	RoHS compliant		

a. Power numbers are provided for passive cables only. For board power numbers while using active cables, please add the outcome of the following formula to the passive cables power numbers stated above: *Active_Module_Power* x N*umber_of_Modules* x 1.1 (efficiency factor)
b. Typical power for ATIS traffic load.
c. For both operational and non-operational states.
d. Airflow is measured in wind tunnel.
e. Contact NVIDIA for airflow numbers with other active modules' power levels.

MCX621202AS-ADAT / MCX621202AC-ADAT Specifications

These cards are optimized for Workstation Environments and include an onboard cooling fan that meets the acoustic requirement for workstations.

- At Idle 20 dBA max
- TDP Room 34 dBA Max
- TDP Max 47 dBA Max

Fan speed is controlled automatically depending on board load.

Physical	**Size**: 6.01in. x 2.71in (152.9mmx 68.9 mm)			
	Connector: Dual SFP28 Ethernet (copper and optical)			
Protocol Support	**Data Rate**:	Ethernet	1/10/25 Gb/s	
	Ethernet: 25GBASE-R, 20GBASE-KR2, 10GBASE-LR,10GBASE-ER, 10GBASE-CX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR			
	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 8 lanes (2.0 and 1.1 compatible)			
Power Specifications[a]	**Voltage**: 12V			
	Power	**Cable Type**	**PCIe Gen 3.0**	**PCIe Gen 4.0**
	Typical Power[b]	Passive Cables	9.6W	9.9W
	Maximum Power	Passive Cables	13.7W	14W
	Maximum power available through SFP28 port: 2.5W (each port)			
	Voltage: 3.3Aux **Maximum current**: 100mA			
Environmental	**Temperature**	Operational	0°C to 55°C	
		Non-operational	-40°C to 70°C	
	Humidity	90% relative humidity[c]		
	Altitude (Operational)	3050m		

Maximum Allowed Inlet Temperature	External Airflow Conditions	Cable Type	Maximum Allowed Fan Inlet Temperature
	No External Airflow	Passive Copper Module	50°
		NVIDIA SFP28 0.8W Module	40°
		10G Base SFP-10G-T-NC 2.5W Cable	40°
	150LFM External Airflow (Airflow Direction: Heatsink to Port)	Passive Copper Module	55°
		NVIDIA SFP28 0.8W Module	50°
		10G Base SFP-10G-T-NC 2.5W Cable	50°
Regulatory	Safety	CB / cTUVus / CE	
	EMC	CE / FCC / VCCI / ICES / RCM	
	RoHS	RoHS compliant	

a. Power numbers are provided for passive cables only. For board power numbers while using active cables, please add the outcome of the following formula to the passive cables power numbers stated above: *Active_Module_Power* x N*umber_of_Modules* x 1.1 (efficiency factor)
b. Typical power for ATIS traffic load.
c. For both operational and non-operational states.

MCX623102AC-GDAT / MCX623102AE-GDAT / MCX623102AN-GDAT / MCX623102AS-GDAT Specifications

Physical	**Size**: 5.59in. x 2.71in (142.00mm x 68.90mm)			
	Connector: Dual SFP56 Ethernet (copper and optical)			
Protocol Support	**Data Rate**:	Ethernet	1/10/25/40/50 Gb/s	
	Ethernet: 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-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR			
	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)			
Power Specifications[a]	**Voltage**: 12V			
	Power	Cable Type	PCIe Gen 3.0	PCIe Gen 4.0
	Typical Power[b]	Passive Cables	14.94W	15.76W
	Maximum Power	Passive Cables	20.16W	20.98W
	Maximum power available through SFP56 port: 2.5W (each port)			

	Voltage: 3.3Aux **Maximum current:** 100mA		
Environmental	**Temperature**	Operational	0°C to 55°C
		Non-operational	-40°C to 70°C
	Humidity	90% relative humidity[c]	
	Altitude (Operational)	3050m	
	Airflow Requirements @ 55C[d][e]		Hot Aisle - Heatsink to Port
		Passive Cable	300LFM
		Active 0.8 Cable	400LFM
		Active 1.5W Cable	500LFM
Regulatory	**Safety**	CB / cTUVus / CE	
	EMC	CE / FCC / VCCI / ICES / RCM	
	RoHS	RoHS compliant	

a. Power numbers are provided for passive cables only. For board power numbers while using active cables, please add the outcome of the following formula to the passive cables power numbers stated above: *Active_Module_Power* x N*umber_of_Modules* x 1.1 (efficiency factor)
b. Typical power for ATIS traffic load.
c. For both operational and non-operational states.
d. Airflow is measured in wind tunnel.
e. Contact NVIDIA for airflow numbers with other active modules' power levels.

MCX623105AN-CDAT / MCX623105AE-CDAT / MCX623105AC-CDAT Specifications

Physical	**Size**: 5.59in. x 2.71in (142.00mm x 68.90mm)		
	Connector: Single QSFP56 Ethernet (copper and optical)		
Protocol Support	**Data Rate**:	Ethernet	1/10/25/40/50/100 Gb/s
	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-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR, 100GBASE-CR2, 100GBASE-KR2, 100GBASE-SR2		
	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)		

Power Specifications[a]	**Voltage**: 12V			
	Power	**Cable Type**	**PCIe Gen 3.0**	**PCIe Gen 4.0**
	Typical Power[b]	Passive Cables	15.67W	16.48W
	Maximum Power	Passive Cables	20.51W	22W
	Maximum power available through QSFP56 port: 5W (each port)			
	Voltage: 3.3Aux **Maximum current:** 100mA			
Environmental	**Temperature**	Operational	0°C to 55°C	
		Non-operational	-40°C to 70°C	
	Humidity	90% relative humidity[c]		
	Altitude (Operational)	3050m		
	Airflow Requirements @ 55C[d][e]		**Hot Aisle - Heatsink to Port**	
		Passive Cable	500LFM	
		Active 3.5W Cable	600LFM	
		NVIDIA Active 2.5W Cable	500LFM	
Regulatory	**Safety**	CB / cTUVus / CE		
	EMC	CE / FCC / VCCI / ICES / RCM		
	RoHS	RoHS compliant		

a. Power numbers are provided for passive cables only. For board power numbers while using active cables, please add the outcome of the following formula to the passive cables power numbers stated above: *Active_Module_Power* x N*umber_of_Modules* x 1.1 (efficiency factor)
b. Typical power for ATIS traffic load.
c. For both operational and non-operational states.
d. Airflow is measured in wind tunnel.
e. Contact NVIDIA for airflow numbers with other active modules' power levels.

MCX623106AS-CDAT / MCX623106AN-CDAT / MCX623106AC-CDAT / MCX623106AE-CDAT Specifications

Physical	**Size**: 5.59in. x 2.71in (142.00mm x 68.90mm)
	Connector: Dual QSFP56 Ethernet (copper and optical)

<table>
<tr><td rowspan="2">Protocol Support</td><td>Data Rate:</td><td>Ethernet</td><td colspan="2">1/10/25/40/50/100 Gb/s</td></tr>
<tr><td colspan="4">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-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR, 100GBASE-CR2, 100GBASE-KR2, 100GBASE-SR2</td></tr>
<tr><td colspan="5">PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)</td></tr>
<tr><td rowspan="5">Power Specifications[a]</td><td colspan="5">Voltage: 12V</td></tr>
<tr><td>Power</td><td>Cable Type</td><td>PCIe Gen 3.0</td><td>PCIe Gen 4.0</td></tr>
<tr><td>Typical Power[b]</td><td>Passive Cables</td><td>18.7W</td><td>19.52W</td></tr>
<tr><td>Maximum Power</td><td>Passive Cables</td><td>25.28W</td><td>26.64W</td></tr>
<tr><td colspan="4">Maximum power available through QSFP56 port: 5W (each port)</td></tr>
<tr><td colspan="5">Voltage: 3.3Aux
Maximum current: 100mA</td></tr>
<tr><td rowspan="6">Environmental</td><td rowspan="2">Temperature</td><td>Operational</td><td colspan="2">0°C to 55°C</td></tr>
<tr><td>Non-operational</td><td colspan="2">-40°C to 70°C</td></tr>
<tr><td>Humidity</td><td colspan="3">90% relative humidity[c]</td></tr>
<tr><td>Altitude (Operational)</td><td colspan="3">3050m</td></tr>
<tr><td rowspan="4">Airflow Requirements @ 55C[d][e]</td><td></td><td colspan="2">Hot Aisle - Heatsink to Port</td></tr>
<tr><td>Passive Cable</td><td colspan="2">550LFM</td></tr>
<tr><td>Active 2.5W Cable</td><td colspan="2">700LFM</td></tr>
<tr><td>Active 3.5W Cable</td><td colspan="2">1100LFM</td></tr>
<tr><td rowspan="3">Regulatory</td><td>Safety</td><td colspan="3">CB / cTUVus / CE</td></tr>
<tr><td>EMC</td><td colspan="3">CE / FCC / VCCI / ICES / RCM</td></tr>
<tr><td>RoHS</td><td colspan="3">RoHS compliant</td></tr>
</table>

a. Power numbers are provided for passive cables only. For board power numbers while using active cables, please add the outcome of the following formula to the passive cables power numbers stated above: *Active_Module_Power* x N*umber_of_Modules* x 1.1 (efficiency factor)
b. Typical power for ATIS traffic load.
c. For both operational and non-operational states.
d. Airflow is measured in wind tunnel.
e. Contact NVIDIA for airflow numbers with other active modules' power levels.

MCX623106PN-CDAT / MCX623106PC-CDAT Specifications

Physical	**Size**: 5.59in. x 2.71in (142.00mm x 68.90mm)			
	Connector: Dual QSFP56 Ethernet (copper and optical)			
Protocol Support	**Data Rate**:	Ethernet	1/10/25/40/50/100 Gb/s	
	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-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR, 100GBASE-CR2, 100GBASE-KR2, 100GBASE-SR2			
	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)			
Power Specifications[a]	**Voltage**: 12V			
	Power	**Cable Type**	**PCIe Gen 3.0**	**Gen 4.0**
	Typical Power[b]	Passive Cables	TBD	18.96W
	Maximum Power	Passive Cables	TBD	26.64W
	Maximum power available through QSFP56 port: 5W (each port)			
	Voltage: 3.3Aux **Maximum current:** 100mA			
Environmental	**Temperature**	Operational	0°C to 55°C	
		Non-operational	-40°C to 70°C	
	Humidity	90% relative humidity[c]		
	Altitude (Operational)	3050m		
	Airflow Requirements @ 55C[d][e]		**Hot Aisle - Heatsink to Port**	
		Passive Cable	600LFM	
		NVIDIA Active 2.5W Cable	700LFM	
		Active 3.5W Cable	1000LFM	
Regulatory	**Safety**	CB / cTUVus / CE		
	EMC	CE / FCC / VCCI / ICES / RCM		
	RoHS	RoHS compliant		

a. Power numbers are provided for passive cables only. For board power numbers while using active cables, please add the outcome of the following formula to the passive cables power numbers stated above: *Active_Module_Power* x N*umber_of_Modules* x 1.1 (efficiency factor)
b. Typical power for ATIS traffic load.
c. For both operational and non-operational states.

d. Airflow is measured in wind tunnel.
e. Contact NVIDIA for airflow numbers with other active modules' power levels.

MCX623106TC-CDAT / MCX623106TN-CDAT / MCX623106GN-CDAT / MCX623106GC-CDAT Specifications

Physical	**Size**: 5.59in. x 2.71in (142.00mm x 68.90mm)			
	Connector: Dual QSFP56 Ethernet (copper and optical)			
Protocol Support	**Data Rate**:	Ethernet	1/10/25/40/50/100 Gb/s	
	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-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR, 100GBASE-CR2, 100GBASE-KR2, 100GBASE-SR2			
	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)			
Power Specifications[a]	**Voltage**: 12V			
	Power	**Cable Type**	**PCIe Gen 3.0**	**PCIe Gen 4.0**
	Typical Power[b]	Passive Cables	TBD	18.96W
	Maximum Power	Passive Cables	TBD	26.64W
	Maximum power available through QSFP56 port: 5W (each port)			
	Voltage: 3.3Aux **Maximum current:** 100mA			
Environmental	**Temperature**	Operational	0°C to 55°C	
		Non-operational	-40°C to 70°C	
	Humidity	90% relative humidity[c]		
	Altitude (Operational)	3050m		
	Airflow Requirements @ 55C[d][e]		**Hot Aisle - Heatsink to Port**	
		Passive Cable	550LFM	
		Active 2.5W Cable	700LFM	
		Active 3.5W Cable	1100LFM	
Regulatory	**Safety**	CB / cTUVus / CE		
	EMC	CE / FCC / VCCI / ICES / RCM		
	RoHS	RoHS compliant		

a. Power numbers are provided for passive cables only. For board power numbers while using active cables, please add the outcome of the following formula to the passive cables power numbers

stated above: *Active_Module_Power* x N*umber_of_Modules* x 1.1 (efficiency factor)
b. Typical power for ATIS traffic load.
c. For both operational and non-operational states.
d. Airflow is measured in wind tunnel.
e. Contact NVIDIA for airflow numbers with other active modules' power levels.

MCX623105AC-VDAT / MCX623105AN-VDAT / MCX623105AS-VDAT / MCX623105AE-VDAT Specifications

Physical	**Size**: 5.59in. x 2.71in (142.00mm x 68.90mm)			
	Connector: Single QSFP56 Ethernet (copper and optical)			
Protocol Support	**Data Rate**:	Ethernet	1/10/25/40/50/100/200 Gb/s	
	Ethernet: 200GBASE-CR4, 200GBASE-KR4, 200GBASE-SR4, 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-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR, 100GBASE-CR2, 100GBASE-KR2, 100GBASE-SR2			
	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)			
Power Specifications[a]	**Voltage**: 12V			
	Power	**Cable Type**	**PCIe Gen 3.0**	**Gen 4.0**
	Typical Power[b]	Passive Cables	TBD	16.94W
	Maximum Power	Passive Cables	TBD	24W
	Maximum power available through QSFP56 port: 5W (each port)			
	Voltage: 3.3Aux **Maximum current**: 100mA			
Environmental	**Temperature**	Operational	0°C to 55°C	
		Non-operational	-40°C to 70°C	
	Humidity	90% relative humidity[c]		
	Altitude (Operational)	3050m		
	Airflow Requirements @ 55C[d] [e]		**Hot Aisle - Heatsink to Port**	
		Passive Cable	600LFM	
		Active 4.55W Cable	950LFM	
Regulatory	**Safety**	CB / cTUVus / CE		
	EMC	CE / FCC / VCCI / ICES / RCM		

	RoHS	RoHS compliant

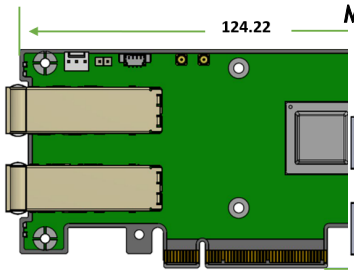
a. Power numbers are provided for passive cables only. For board power numbers while using active cables, please add the outcome of the following formula to the passive cables power numbers stated above: *Active_Module_Power* x N*umber_of_Modules* x 1.1 (efficiency factor)
b. Typical power for ATIS traffic load.
c. For both operational and non-operational states.
d. Airflow is measured in wind tunnel.
e. Contact NVIDIA for airflow numbers with other active modules' power levels.

Board Mechanical Drawing and Dimensions

⚠ 3D model of the cards are available through the customer portal following login.

⚠ All dimensions are in millimeters. Mechanical tolerances are specified for each form factor.

Dual-Port SFP28/SFP56 x8 Adapter Cards

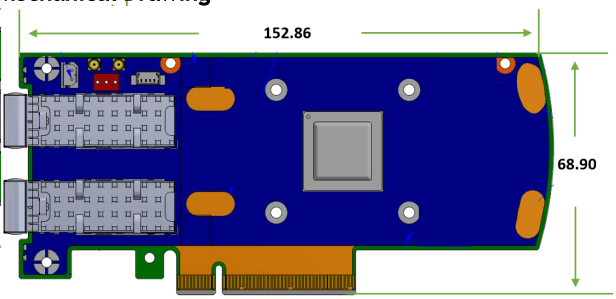


Mechanical Drawing

Mechanical Tolerance:

Width: +/- 0.13mm
Height: +0/-0.13mm

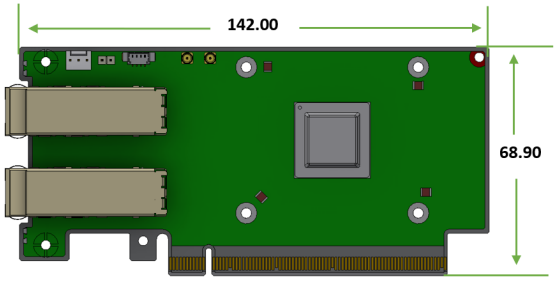
Dual-Port SFP28 x8 Adapter Cards with Active Cooling Mechanical Drawing



Mechanical Tolerance:

Width: +/- 0.13mm
Height: +0/-0.2mm

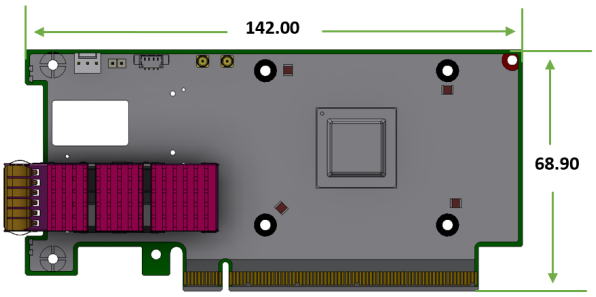
Dual-Port SFP28/SFP56 x16 Adapter Cards Mechanical Drawing



Mechanical Tolerance:

Width: +/- 0.13mm
Height: +0/-0.13mm

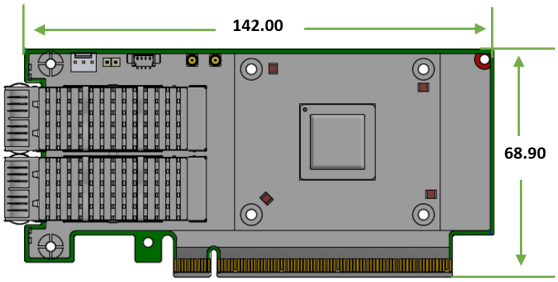
Single-Port QSFP56 x16 Adapter Cards Mechanical Drawing



Mechanical Tolerance:

Width: +/- 0.13mm
Height: +0/-0.13mm

Dual-Port QSFP56 x16 Adapter Cards Mechanical Drawing

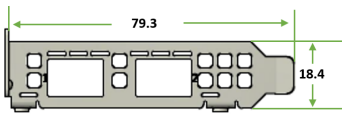
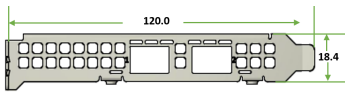


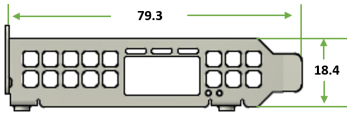
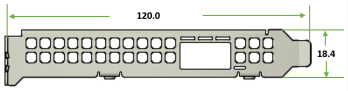
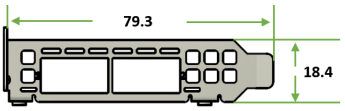
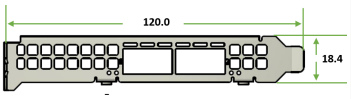
Mechanical Tolerance:

Width: +/- 0.13mm
Height: +0/-0.13mm

Bracket Mechanical Drawing

All dimensions are in millimeters. All the mechanical tolerances are +/- 0.2mm.

Card Configuration	Short Bracket	Tall Bracket
Dual-Port SFP28/SFP56 Cards		

Card Configuration	Short Bracket	Tall Bracket
Single-Port QSFP56 Cards		
Dual-Port QSFP56 Cards		

Finding the MAC on the Adapter Card

Each NVIDIA adapter card has a different identifier printed on the label: serial number and the card MAC for the Ethernet protocol.

> The product revisions indicated on the labels in the following figures do not necessarily represent the latest revisions of the cards.

MCX623105AS-VDAT Board Label Example

Document Revision History

Date	Revision	Description of Changes
Aug. 2022	3.0	Updated the "Legacy (EOL) Ordering Part Numbers" table.
Jun. 2022	2.9	Updated board and bracket mechanical drawings and mechanical tolerances.
Mar. 2022	2.8	Added the following OPNs to relevant sections: • MCX621202AS-ADAT • MCX621202AC-ADAT
Jan. 2022	2.7	Added table "Legacy (EOL) Ordering Part Numbers"
Sept. 2021	2.6	Added OPN MCX623105AC-CDAT Updated Specifications table format.
Aug. 2021	2.5	Added the following OPNs: • MCX623106TN-CDAT • MCX623106TC-CDAT • MCX623106GN-CDAT • MCX623106GC-CDAT • MCX621202AS-ADAT • MCX621202AC-ADAT
Jun. 2021	2.4	Updated Interfaces.
Mar. 2021	2.3	Updated Troubleshooting.
Mar. 2021	2.2	Updated Protocol Support in Specifications.
Mar. 2021	2.1	Added OPN MCX623102AS-ADAT
Feb. 2021	2.0	Updated MCX623102A[C/N/S/E]-GDAT airflow numbers.
Dec. 2020	1.9	Updated cards' dimensions for MCX621102A[C/E/N]-ADAT.
Sep. 2020	1.8	Updated power numbers in Specifications.
Aug. 2020	1.7	Updated power numbers in Specifications.
Aug. 2020	1.6	Updated LED specifications in Specifications.
Jul. 2020	1.5	Updated power numbers in Specifications.
Jul. 2020	1.4	Updated power numbers in Specifications.

Date	Revision	Description of Changes
Jun. 2020	1.3	Updated airflow numbers. Added the following OPNs to all relevant sections: • MCX621102AE-ADAT • MCX623102AS-GDAT • MCX623102AC-GDAT • MCX623106AE-CDAT • MCX623106PC-CDAT • MCX623106PN-CDAT • MCX623106PE-CDAT • MCX623105AE-VDAT
May. 2020	1.2	Updated power numbers.
Feb. 2020	1.1	Added the following OPNs to all relevant sections: • MCX623106AS-CDAT • MCX623105AS-VDAT • MCX623102AS-GDAT
Nov. 2019	1.0	First release

Notice

This document is provided for information purposes only and shall not be regarded as a warranty of a certain functionality, condition, or quality of a product. Neither NVIDIA Corporation nor any of its direct or indirect subsidiaries and affiliates (collectively: “NVIDIA”) make any representations or warranties, expressed or implied, as to the accuracy or completeness of the information contained in this document and assumes no responsibility for any errors contained herein. NVIDIA shall have no liability for the consequences or use of such information or for any infringement of patents or other rights of third parties that may result from its use. This document is not a commitment to develop, release, or deliver any Material (defined below), code, or functionality.

NVIDIA reserves the right to make corrections, modifications, enhancements, improvements, and any other changes to this document, at any time without notice.

Customer should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

NVIDIA products are sold subject to the NVIDIA standard terms and conditions of sale supplied at the time of order acknowledgement, unless otherwise agreed in an individual sales agreement signed by authorized representatives of NVIDIA and customer (“Terms of Sale”). NVIDIA hereby expressly objects to applying any customer general terms and conditions with regards to the purchase of the NVIDIA product referenced in this document. No contractual obligations are formed either directly or indirectly by this document.

NVIDIA products are not designed, authorized, or warranted to be suitable for use in medical, military, aircraft, space, or life support equipment, nor in applications where failure or malfunction of the NVIDIA product can reasonably be expected to result in personal injury, death, or property or environmental damage. NVIDIA accepts no liability for inclusion and/or use of NVIDIA products in such equipment or applications and therefore such inclusion and/or use is at customer’s own risk.

NVIDIA makes no representation or warranty that products based on this document will be suitable for any specified use. Testing of all parameters of each product is not necessarily performed by NVIDIA. It is customer’s sole responsibility to evaluate and determine the applicability of any information contained in this document, ensure the product is suitable and fit for the application planned by customer, and perform the necessary testing for the application in order to avoid a default of the application or the product. Weaknesses in customer’s product designs may affect the quality and reliability of the NVIDIA product and may result in additional or different conditions and/or requirements beyond those contained in this document. NVIDIA accepts no liability related to any default, damage, costs, or problem which may be based on or attributable to: (i) the use of the NVIDIA product in any manner that is contrary to this document or (ii) customer product designs.

No license, either expressed or implied, is granted under any NVIDIA patent right, copyright, or other NVIDIA intellectual property right under this document. Information published by NVIDIA regarding third-party products or services does not constitute a license from NVIDIA to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property rights of the third party, or a license from NVIDIA under the patents or other intellectual property rights of NVIDIA.

Reproduction of information in this document is permissible only if approved in advance by NVIDIA in writing, reproduced without alteration and in full compliance with all applicable export laws and regulations, and accompanied by all associated conditions, limitations, and notices.

THIS DOCUMENT AND ALL NVIDIA DESIGN SPECIFICATIONS, REFERENCE BOARDS, FILES, DRAWINGS, DIAGNOSTICS, LISTS, AND OTHER DOCUMENTS (TOGETHER AND SEPARATELY, “MATERIALS”) ARE BEING PROVIDED “AS IS.” NVIDIA MAKES NO WARRANTIES, EXPRESSED, IMPLIED, STATUTORY, OR OTHERWISE WITH RESPECT TO THE MATERIALS, AND EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. TO THE EXTENT NOT PROHIBITED BY LAW, IN NO EVENT WILL NVIDIA BE LIABLE FOR ANY DAMAGES, INCLUDING WITHOUT LIMITATION ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE, OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED AND REGARDLESS OF THE THEORY OF LIABILITY, ARISING OUT OF ANY USE OF THIS DOCUMENT, EVEN IF NVIDIA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Notwithstanding any damages that customer might incur for any reason whatsoever, NVIDIA’s aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms of Sale for the product.

Trademarks

NVIDIA, the NVIDIA logo, and Mellanox are trademarks and/or registered trademarks of NVIDIA Corporation and/or Mellanox Technologies Ltd. in the U.S. and in other countries. Other company and product names may be trademarks

of the respective companies with which they are associated.

Copyright
© 2022 NVIDIA Corporation & affiliates. All Rights Reserved.