



## World-Class Performance Ethernet SmartNICs Product Line

Ethernet Network Adapters with Advanced Hardware Accelerators, Unequaled RoCE Capabilities and Enhanced Security, Enabling Data Center Efficiency and Scalability

Mellanox® **Ethernet Network Interface Cards (NICs)** enable the highest data center performance for hyperscale, public and private clouds, storage, machine learning, artificial intelligence, big data and telco platforms

## World-Class Performance and Scale

Mellanox ConnectX Ethernet SmartNICs offer best-in-class network performance serving low-latency, high throughput applications at 10, 25, 40, 50, 100 and up to 200 Gb/s Ethernet speeds. Mellanox Ethernet adapters deliver industry-leading connectivity for performance-driven server and storage applications. These ConnectX adapter cards enable high bandwidth coupled with ultra-low latency for diverse applications and systems, resulting in faster access and real-time responses.

ConnectX adapter cards provide best-in-class performance and efficient computing through advanced acceleration and offload capabilities, including RDMA over Converged Ethernet (RoCE), NVMe-over-Fabrics (NVMe-oF), virtual switch offloads, GPU communication acceleration, hardware acceleration for virtualization, encryption/decryption hardware acceleration, and the connectivity of multiple compute or storage hosts to a single interconnect adapter. ConnectX network acceleration technology frees the CPU resources for compute tasks, allowing for higher scalability and efficiency within.

ConnectX adapter cards are part of Mellanox's complete end-to-end Ethernet networking portfolio for data centers which also includes Open Ethernet switches, application acceleration packages, and cabling to deliver a unique price-performance value proposition for network and storage solutions. Using Mellanox, IT managers can be assured of the highest performance, reliability and most efficient network fabric at the lowest cost for the best return on investment.



## Advanced Switching and Packet Processing

Mellanox ConnectX adapters provide comprehensive support for virtualized data centers with Single-Root I/O Virtualization (SR-IOV), allowing dedicated adapter resources and virtual machine isolation and protection. I/O virtualization improves server utilization and LAN and SAN unification while reducing cost, power and cable complexity.

Virtual machines running in a server traditionally use hypervisor's switch capabilities, such as Open vSwitch (OVS). Mellanox ASAP<sup>2</sup> - Accelerated Switching and Packet Processing<sup>®</sup> technology allows offloading the implementation of a virtual switch or virtual router by handling the data plane in the NIC hardware, without modifying the control plane. This achieves significantly higher Switch/vRouter performance without the associated CPU load.

## RDMA over Converged Ethernet (RoCE)

Mellanox adapter cards offer RoCE to provide efficient data transfer with very low latencies on Ethernet networks — a key factor in maximizing a cluster's ability to process data instantaneously. With the increasing use of fast and distributed storage, data centers have reached the point of yet another disruptive change, making RoCE a must in today's data centers. In ConnectX-5 and above, RoCE can operate in lossy fabrics without the need to configure PFC or ECN.

## Security from Zero Trust to Hero Trust

In an era where privacy of information is key and zero trust is the rule, Mellanox ConnectX Ethernet adapters bring security down to the end-points, with unprecedented performance and scalability. Mellanox ConnectX adapters support secure firmware update, while options for AES-XTS block-level data-at-rest encryption/decryption offload are available starting from ConnectX-6. ConnectX-6 Dx also includes IPsec and TLS data-in-motion inline encryption/decryption offload, as well as enables a hardware-based L4 firewall. For an added level of security, ConnectX-6 Dx uses embedded Hardware Root-of-Trust (RoT) to implement secure boot.

## FEATURES & BENEFITS

- Smart interconnect for x86, Power, Arm, and GPU-based compute and storage platforms
- Industry-leading throughput and latency performance
- A single adapter supports TCP/IP, storage, and RDMA over Ethernet transport protocols for I/O consolidation
- Supports industry-standard SR-IO Virtualization technology with delivery of VM protection and granular levels of QoS to applications
- In-line encryption/decryption capabilities
- Provides high-availability for data center networking
- Cutting-edge performance in virtualized Overlay Networks (VXLAN and GENEVE)
- Enables increased VM count per server ratio
- Secure FW update and secure boot options
- Software compatible with standard TCP/UDP/IP and iSCSI stacks
- Open Data Center Committee (ODCC) compatible

## TARGET APPLICATIONS

- Data center virtualization
- Public and private clouds, storage platforms
- Machine learning, artificial intelligence, Big Data and data analysis platforms
- Clustered database applications and high-throughput data warehousing
- Latency-sensitive applications such as financial analysis and high frequency trading
- Media and entertainment applications
- Telco platforms

## Flexible Mellanox Multi-Host® Technology

Mellanox Multi-Host provides high flexibility and major savings in building next generation, scalable data centers. Mellanox Multi-Host enables separating a single interconnect adapter PCIe interface into multiple and independent PCIe interfaces, without degrading performance. For better power and performance management, Mellanox enables designing and building scale-out heterogeneous compute and storage racks with direct connectivity among compute elements, storage elements and the network, minimizing CAPEX and OPEX.

## Accelerated Storage

A consolidated compute and storage network achieves significant cost-performance advantages over multi-fabric networks. Standard block and file access protocols leverage RDMA to achieve high-performance storage access. Supporting a rich variety of storage protocols, Mellanox adapters enable partners to build hyperconverged platforms where the compute and storage nodes are co-located and share the same infrastructure. Leveraging RDMA, Mellanox adapters enhance numerous storage protocols, such as iSCSI over RDMA (iSER), NFS RDMA, and SMB Direct. Moreover, ConnectX adapters also offer NVMe-oF protocols and offloads, enhancing the utilization of NVMe based storage appliances. Another storage related hardware offload is the Signature Handover mechanism based on an advanced T-10/DIF implementation.

## Enhancing Machine Learning Application Performance

Mellanox Ethernet adapters with built-in advanced acceleration and RDMA capabilities deliver best-in-class latency, bandwidth and message rates, coupled with low CPU utilization. Mellanox PeerDirect® technology with NVIDIA GPUDirect™ RDMA enables adapters with direct peer-to-peer communication to GPU memory with no interruption to CPU operations. Mellanox adapters also deliver the highest scalability, efficiency, and performance for a variety of applications, including bioscience, media and entertainment, automotive design, computational fluid dynamics and manufacturing, weather research and forecasting, as well as oil and gas industry modeling.

## Host Management

Mellanox host management sideband implementations enable remote monitor and control capabilities using RBT, MCTP over SMBus, and MCTP over PCIe – Baseboard protocols using these interfaces. Mellanox adapters support these protocols to offer numerous Host Management features including PLDM for Firmware Update, network boot in UEFI driver, UEFI secure boot, and more. Management Controller (BMC) interface, which supports both NC-SI and PLDM management

## Various Form Factors

Mellanox offers a variety of adapters in different form factors to meet the specific needs of any data center. In addition to standard PCIe adapter cards, Mellanox offers Open Compute Project (OCP) cards; these integrate into the most cost-efficient, energy- efficient and scalable enterprise and hyperscale data centers, delivering leading connectivity for performance-driven server and storage applications. ConnectX OCP adapter cards are available supporting OCP Specifications 2.0 and 3.0.

Another unique form-factor network adapter consisting of two PCIe cards, whose PCIe lanes are split between two slots. This configuration maximizes PCIe bandwidth beyond a server's single PCIe slot limit, such as when connecting x32 lanes of PCIe Gen 3.0 to achieve 200GbE. This configuration is also very useful in dual socket servers that utilize Mellanox Socket Direct® technology.



## Broad Software Support

All Mellanox adapter cards are supported by a full suite of drivers for Linux major distributions, Microsoft® Windows®, VMware vSphere® and FreeBSD®. Drivers are also available in-box in Linux main distributions, Windows and VMware.



## ConnectX®-6 Dx SmartNIC

ConnectX-6 Dx is the world's most advanced cloud SmartNIC, providing up to two ports of 25, 50 or 100 GbE, or a single port of 200GbE connectivity, powered by 50Gb/s per lane PAM4 SerDes technology and PCIe Gen 4.0 host connectivity. Continuing along Mellanox's innovation path in scalable cloud fabrics, ConnectX-6 Dx provides unparalleled performance and efficiency at every scale. ConnectX-6 Dx's innovative hardware offload engines, including IPsec, TLS inline data-in-motion encryption and AES-XTS block level encryption, are ideal for enabling secure network connectivity in modern data-center and storage environments. Additionally, ConnectX-6 Dx offers improvements through offloading capabilities such as Zero Touch RoCE and VirtIO hardware acceleration, alongside Mellanox Multi-Host and other performance improvements. ConnectX-6 Dx is available in low profile PCIe, OCP 3.0 and OCP 2.0 form factors with SFP28, SFP56 or QSFP56 network connectors.

## ConnectX®-6 Lx SmartNIC

ConnectX-6 Lx is the industry's most cost efficient, secure, and agile SmartNIC for cloud, edge, telco, and enterprise workloads. ConnectX-6 Lx delivers best-in-breed capabilities including network virtualization acceleration, infrastructure security, and advanced networking features for SDN while delivering the best total cost of ownership and efficiency. ConnectX-6 Lx offers innovative hardware offload engines, including IPsec encryption/decryption, for accelerating secure network connectivity as well as Mellanox's ASAP<sup>2</sup> - Accelerated Switch and Packet Processing<sup>®</sup> offload for SR-IOV and VirtIO. The ConnectX-6 Lx SmartNIC provides up to two ports of 25GbE or a single-port of 50GbE connectivity, and is available in low profile PCIe or OCP 3.0 form factors, for PCIe Gen 3.0 or Gen 4.0 servers.

## ConnectX®-6 SmartNIC

ConnectX-6, the world's first 200Gb/s Ethernet network adapter card, offers world-leading performance, smart offloads and in-network computing. Delivering two ports of up to 200GbE connectivity using PAM4 technology, sub-800ns latency and industry-leading 215 million messages per second, ConnectX-6 offers new features and performance improvements over previous generations, such as data-at-rest storage encryption and advanced host-chaining. ConnectX-6 network adapters are available for PCIe Gen 3.0 and Gen 4.0 servers, with x32 or x16 lane options, and provide support for 100GbE and 200GbE speeds in standup PCIe and OCP 3.0 form factors, as well as with Mellanox Multi-Host and Mellanox Socket Direct offerings.

## ConnectX®-5 Adapter Card

ConnectX-5 adapter cards provide up to two ports of 100GbE connectivity, while also delivering innovative network accelerations, such as an embedded PCIe Switch for advanced OVS offloads, NVMe over Fabric Target offloads, and Signature Handover (T10-DIF) in hardware. ConnectX-5 network adapters are available for PCIe Gen 3.0 and Gen 4.0 (ConnectX-5 Ex) servers; provide support for 25, 40, 50 and 100 GbE speeds in standup PCIe and OCP 2.0/3.0 form factors; and also offer advanced Mellanox Multi-Host and Mellanox Socket Direct.

## ConnectX®-4 Lx Adapter Card

ConnectX-4 Lx adapter cards are flexible, agile and high performance NICs for cloud applications, supporting 10, 25, 40 and 50 GbE connectivity and providing a combination of bandwidth with sub-microsecond latency. ConnectX-4 Lx also includes native hardware support for RDMA over Converged Ethernet (RoCE) and Ethernet stateless offloads. ConnectX-4 Lx network adapters are available for PCIe Gen 3.0 servers in low profile PCIe and OCP 2.0/3.0 form factors.

ConnectX-4Lx

ConnectX-5

ConnectX-6

ConnectX-6Dx

ConnectX-6Lx

General Specs					
Ports	Single, Dual	Single, Dual	Single, Dual	Single, Dual	Single, Dual
Port Speed (Gb/s)	1, 10, 25, 40, 50 (x1)	1, 10, 25, 40, 50, 100	1, 10, 25, 40, 50, 100, 200	1, 10, 25, 40, 50, 100, 200 (x1)	1, 10, 25, 50 (x1)
PCI Express (PCIe) Interface	Gen 3.0 x8	Gen 3.0 x16; Gen 4.0 x16	2x Gen 3.0 x16; Gen 4.0 x16	Gen 4.0 x16	Gen 4.0 x8
Connectors	SFP28; QSFP28	SFP28; QSFP28	QSFP56	SFP56; QSFP56	SFP28; QSFP28
Message Rate (DPDK) (million msgs/sec)	75	200 (ConnectX-5 Ex, Gen4 server), 148 (ConnectX-5, Gen3)	215	215	75
RoCE Latency at Max. Speed	0.83	0.8 (ConnectX-5) 0.7 (ConnectX-5 Ex)	0.8	0.8	TBD
OOO RDMA (Adaptive Routing)	–	✓	✓	✓	✓
Dynamically Connected Transport	✓	✓	✓	✓	✓
Flexible Pipeline Programmability	–	✓	✓	✓	✓
Packet Pacing	–	✓	✓	✓	✓
Host Chaining	–	✓	✓✓	✓✓	✓
Host Management	✓	✓	✓	✓	✓
Embedded PCIe Switch	–	✓	✓	✓	–
RoCE					
Zero Touch RoCE (ZTR)	✓	✓	✓	✓	✓
RoCE Selective Repeat	–	–	–	✓	✓
RoCE Programmable Congestion Control	–	–	–	✓	–
Storage					
NVMe-oF Target Offload	–	✓	✓	✓	✓
T-10 Dif/Signature Handover	–	✓	✓	✓	–
Burst Buffer Offloads	–	✓	✓	✓	✓

ConnectX-4Lx

ConnectX-5

ConnectX-6

ConnectX-6 Dx

ConnectX-6Lx

Security					
Secure Firmware Update	✓	✓	✓	✓	✓
Secure Boot (HW RoT)	–	–	–	✓	✓
Connection Tracking (L4 firewall)	–	–	✓	✓✓	✓✓
IPsec and TLS data-in-motion inline encryption/decryption	–	–	–	✓	IPsec only
Block-level Encryption/Decryption (AES-XTS)	–	–	✓	✓	–
Virtualization & Cloud					
SR-IOV	8 PFs/port, 256 VFs	8 PFs/host, 512 VFs	8 PFs/host, 1K VFs	8 PFs, 1K VFs/port	8 PFs, 512 VFs/port
Mellanox Multi-Host	4 hosts	4 hosts	8 hosts	4 hosts	–
Congestion Control (ECN)	✓	✓	✓	✓	✓
ASAP <sup>2</sup> (Virtual Switch offload)	–	✓	✓	✓	✓
VirtIO Hardware Emulation	–	–	–	✓	✓
RoCE over Overlay Networks	–	✓	✓	✓	✓
Stateless Offloads for Overlay Network Tunneling Protocols	✓	✓	✓	✓	✓
Hardware Offload of Encapsulation and Decapsulation of VXLAN, NVGRE, and GENEVE Overlay Networks	–	✓	✓	✓ +GTP	✓ +GTP
Available Form Factors					
Low Profile PCIe	✓	✓	✓	✓	✓
OCPC 2.0	✓	✓	–	✓	TBD
OCPC 3.0 (SFF)	✓	✓	✓	✓	✓
Mellanox Socket Direct	–	✓	✓	✓	–



# Ethernet

For detailed information on features, compliance, and compatibility, please see each product's specific product brief.



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This brochure describes hardware features and capabilities. Please refer to the driver release notes on [mellanox.com](http://mellanox.com) for feature availability.  
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