



# ConnectX<sup>®</sup>-4 EN IC

## 100Gb/s Ethernet Adapter IC



Single/Dual-Port 10/25/40/50/56/100 Gigabit Ethernet Adapter supporting Multi-Host<sup>™</sup> Technology

ConnectX<sup>®</sup>-4 EN Network Controller with 10/25/40/50/56/100Gb/s Ethernet connectivity provides the highest performance and most flexible solution for high-performance, Web 2.0, Cloud, data analytics, database, and storage platforms.

With the exponential increase and usage of data, the advantages in scientific algorithms, and the creation of new applications, the demand for the highest interconnect throughput, lowest latency and sophisticated data acceleration engines continues to increase. ConnectX-4 EN enables data centers to leverage the world's leading interconnect adapter for increasing their applications while reducing operational and capital expenses.

ConnectX-4 EN provides an unmatched combination of 100Gb/s bandwidth, sub 700ns latency and 100 million messages per second. It includes native hardware support for RDMA over Ethernet, Ethernet stateless offload engines, GPUDirect<sup>®</sup>, and the Multi-Host Technology.

The Multi-Host Technology enables the next generation scalable data center design to achieve maximum CAPEX and OPEX savings without compromising on network performance.

### 100GB/S ETHERNET ADAPTER

ConnectX-4 offers the highest throughput Ethernet adapter, supporting 100Gb/s Ethernet and enabling seamless networking, clustering, or storage. 100Gb/s reduces application runtime, and offers the flexibility and scalability to make infrastructure run as efficiently and productively as possible. Moreover, when combined with ConnectX-4 EN's extremely low latency, such throughput provides the best possible return-on-investment (ROI).

### MELLANOX MULTI-HOST<sup>™</sup> TECHNOLOGY

Mellanox's ConnectX-4 Multi-Host technology enables connecting multiple hosts into a single interconnect adapter by separating the ConnectX-4 PCIe interface into multiple and separate interfaces. Each interface can be connected to a separate host with no performance degradation. ConnectX-4 offers four fully-independent PCIe buses, lowering total cost of ownership in the data center by reducing CAPEX requirements from four cables, NICs, and switch ports to only one of each, and by reducing OPEX by cutting down on switch port management and overall power usage.

Each host can be active or inactive at any time, independent of the other hosts, and receives bandwidth of its own. Bandwidth is split between the hosts, either evenly (default) or based on configurable differentiated Quality of Service (QoS), depending on the data center's needs.

Multi-Host technology features uncompromising independent host management, with full independent NC-SI/MCTP support to each host and to the NIC. IT managers can remotely control the configuration and power state of each host individually, such that management of one host does not affect host traffic performance or the management of the other hosts, guaranteeing host security and isolation.

## HIGHLIGHTS

### BENEFITS

- 10/25/40/50/56/100GbE connectivity for servers and storage
- Industry-leading throughput and low latency performance for Web access and storage performance
- Maximizing data centers' return on investment (ROI) with Multi-Host technology
- Efficient I/O consolidation, lowering data center costs and complexity
- Virtualization acceleration
- Software compatible with standard TCP/UDP/IP and iSCSI stacks
- Small PCB footprint

### FEATURES

- Up to 100Gb/s Ethernet per port
- Multi-Host technology – connectivity to up to 4 independent hosts
- 10/25/40/50/56/100Gb/s speeds
- Virtualization
- Low latency RDMA over Ethernet
- Hardware offloads for NVGRE and VXLAN encapsulated traffic
- CPU offloading of transport operations
- Application offloading
- Mellanox PeerDirect<sup>™</sup> communication acceleration
- End-to-end QoS and congestion control
- Hardware-based I/O virtualization
- Erasure Coding offload
- T10-DIF Signature Handover
- Typical power of 100GbE 1-port – 11.2W (ATIS score)
- RoHS2-R6

To further lower the total cost of ownership, ConnectX-4 supports management of the multiple hosts using a single BMC, with independent NC-SI/MCTP management channels for each of the managed hosts.

Multi-Host also supports a heterogeneous data center architecture; the various hosts connected to the single adapter can be x86, Power, GPU, or Arm, thereby removing any limitations in passing data or communicating between CPUs.

## I/O VIRTUALIZATION

ConnectX-4 EN SR-IOV technology provides dedicated adapter resources and guaranteed isolation and protection for virtual machines (VMs) within the server. I/O virtualization with ConnectX-4 EN gives data center administrators better server utilization while reducing cost, power, and cable complexity, allowing more Virtual Machines and more tenants on the same hardware. ConnectX-4 EN's SR-IOV capability and Multi-Host technology are mutually exclusive, and each host in a Multi-Host server can leverage an individual SR-IOV implementation.

## 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. While this solves network scalability issues, it hides the TCP packet from the hardware offloading engines, placing higher loads on the host CPU. ConnectX-4 EN effectively addresses this by providing advanced NVGRE hardware offloading engines that encapsulate and de-encapsulate the overlay protocol headers, and enable the traditional offloads to be performed on the encapsulated traffic for these and other tunneling protocols (GENEVE, MPLS, QinQ, and so on). With ConnectX-4 EN, data center operators can achieve native performance in the new network architecture.

## RDMA OVER CONVERGED ETHERNET (RoCE)

ConnectX-4 EN supports RoCE specifications delivering low-latency and high performance over Ethernet networks. Leveraging data center bridging (DCB) capabilities as well as ConnectX-4 EN advanced congestion control hardware mechanisms, RoCE provides efficient low-latency RDMA services over Layer 2 and Layer 3 networks.

## MELLANOX PEERDIRECT™

PeerDirect™ communication provides high efficiency RDMA access by eliminating unnecessary internal data copies between components on the PCIe bus (for example, from GPU to CPU), and therefore significantly

reduces application run time. ConnectX-4 EN advanced acceleration technology enables higher cluster efficiency and scalability to tens of thousands of nodes.

## STORAGE ACCELERATION

Storage applications will see improved performance with the higher bandwidth ConnectX-4 EN delivers. Moreover, standard block and file access protocols can leverage RoCE for high-performance storage access. A consolidated compute and storage network achieves significant cost-performance advantages over multi-fabric networks.

## DISTRIBUTED RAID

ConnectX-4 EN delivers advanced Erasure Coding offloading capability, enabling distributed Redundant Array (RAID) of Inexpensive Disks, a data storage technology that combines multiple disk drive components into a logical unit for the purposes of data redundancy and performance improvement.

ConnectX-4 EN's Reed-Solomon capability introduces redundant block calculations, which, together with RDMA, achieves high performance and reliable storage access.

## SIGNATURE HANDOVER

ConnectX-4 EN supports hardware checking of T10 Data Integrity Field/Protection Information (T10-DIF/PI), reducing the CPU overhead and accelerating delivery of data to the application. Signature handover is handled by the adapter on ingress and/or egress packets, reducing the load on the CPU at the Initiator and/or Target machines.

## STANDARD & MULTI-HOST MANAGEMENT

Mellanox's host management technology for standard and multi-host platforms optimizes board management and power, performance and firmware update management via NC-SI, MCTP over SMBus and MCTP over PCIe, as well as PLDM for Monitor and Control DSP0248 and PLDM for Firmware Update DSP0267.

## SOFTWARE SUPPORT

All Mellanox adapter cards are supported by Windows, Linux distributions, VMware, FreeBSD, and Citrix XENServer. ConnectX-4 EN supports various management interfaces and has a rich set of tool for configuration and management across operating systems.

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## COMPATIBILITY

### PCI Express Interface

- PCIe Gen 3.0 compliant, 1.1 and 2.0 compatible
- 2.5, 5.0, or 8.0GT/s link rate x16
- Auto-negotiates to x16, x8, x4, x2, or x1
- Support for MSI/MSI-X mechanisms

### Operating Systems/Distributions\*

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

### Connectivity

- Interoperable with 10/25/40/50/56/100Gb Ethernet switches
- Passive copper cable with ESD protection
- Powered connectors for optical and active cable support

## FEATURES

### Ethernet

- 100GbE / 56GbE / 50GbE / 40GbE / 25GbE / 10GbE
- IEEE 802.3bj, 802.3bm 100 Gigabit Ethernet
- 25G Ethernet Consortium 25, 50 Gigabit Ethernet
- IEEE 802.3ba 40 Gigabit Ethernet
- IEEE 802.3ae 10 Gigabit Ethernet
- IEEE 802.3az Energy Efficient Ethernet
- IEEE 802.3ap based auto-negotiation and KR startup
- Proprietary Ethernet protocols (20/40GBASE-R2, 50/56GBASE-R4); may be available on specific SKUs
- 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)

### Enhanced Features

- Hardware-based reliable transport
- Collective operations offloads
- Vector collective operations offloads
- PeerDirect™ RDMA (aka GPUDirect®) communication acceleration
- 64/66 encoding
- Dynamically Connected transport (DCT)
- Enhanced Atomic operations
- Registration free RDMA memory access

### Multi-Host

- Up to 4 separate PCIe interfaces to 4 independent hosts
  - Two PCIe x8 to two hosts or four PCIe x4 to four hosts
- Independent NC-SI SMBus interfaces
- Independent stand-by and wake-on-LAN signals

### Storage Offloads

- RAID offload - erasure coding (Reed-Solomon) offload
- T10 DIF - Signature handover operation at wire speed, for ingress and egress traffic:

### Overlay Networks

- Stateless offloads for overlay networks and tunneling protocols

- Hardware offload of encapsulation and decapsulation of NVGRE overlay networks

### Hardware-Based I/O Virtualization

- Single Root IOV
- Multi-function per port
- Address translation and protection
- Multiple queues per virtual machine
- Enhanced QoS for vNICs
- VMware NetQueue support

### Virtualization

- SR-IOV: Up to 256 Virtual Functions
- SR-IOV: Up to 16 Physical Functions per port
  - Virtualizing Physical Functions on a physical port
  - SR-IOV on every Physical Function
- 1K ingress and egress QoS levels
- Guaranteed QoS for VMs

### CPU Offloads

- RDMA over Converged Ethernet (RoCE)
- TCP/UDP/IP stateless offload
- LSO, LRO, checksum offload
- RSS (can be done on encapsulated packet), TSS, HDS, VLAN insertion / stripping, Receive flow steering
- Intelligent interrupt coalescence

### Protocol Support

- OpenMPI, IBM PE, OSU MPI (MVAPICH/2), Intel MPI
- Platform MPI, UPC, Open SHMEM
- TCP/UDP, MPLS, VXLAN, NVGRE, GENEVE
- iSER, NFS RDMA, SMB Direct
- uDAPL

### Management and Control Interfaces

- NC-SI, MCTP over SMBus and MCTP over PCIe - Baseboard Management Controller interface
- PLDM for Monitor and Control DSP0248
- PLDM for Firmware Update DSP0267
- SDN management interface for managing the eSwitch
- I<sup>2</sup>C interface for device control and configuration
- General Purpose I/O pins
- SPI interface to Flash
- JTAG IEEE 1149.1 and IEEE 1149.6

### Remote Boot

- Remote boot over Ethernet
- Remote boot over iSCSI
- PXE and UEFI

\* This section describes hardware features and capabilities. Please refer to the driver and firmware release notes for feature availability.

Table 1 - Part Numbers and Descriptions

OPN	Description
MT27704A0-FDCF-BE	ConnectX-4 EN, 1-port IC, 40/56GbE, PCIe 3.0 x16 (RoHS2-R6)
MT27708A0-FDCF-BE	ConnectX-4 EN, 2-port IC, 40/56GbE, PCIe 3.0 x16 (RoHS2-R6)
MT27708A0-FDCF-BEM	ConnectX-4 EN, 2-port IC, 40/56GbE, Multi-Host, PCIe 3.0 x16 (RoHS2-R6)
MT27704A0-FDCF-GE	ConnectX-4 EN, 1-port IC, 50GbE, PCIe 3.0 x16 (ROHS2-R6)
MT27708A0-FDCF-GE	ConnectX-4 EN, 2-port IC, 50GbE, PCIe 3.0 x16 (ROHS2-R6)
MT27708A0-FDCF-GEM	ConnectX-4 EN, 2-port IC, 50GbE, Multi-Host, PCIe 3.0 x16 (ROHS2-R6)
MT27704A0-FDCF-CE	ConnectX-4 EN, 1-port IC, 100GbE, PCIe 3.0 x16 (RoHS2-R6)
MT27708A0-FDCF-CE	ConnectX-4 EN, 2-port IC, 100GbE, PCIe 3.0 x16 (RoHS2-R6)
MT27704A0-FDCF-CEM	ConnectX-4 EN, 1-port IC, 100GbE, Multi-Host, PCIe 3.0 x16 (ROHS2-R6)
MT27708A0-FDCF-CEM	ConnectX-4 EN, 2-port IC, 100GbE, Multi-Host, PCIe 3.0 x16 (ROHS2-R6)



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