



# ConnectX<sup>®</sup>-6 EN IC

## 200GbE Ethernet Adapter IC




World's first 200GbE Ethernet network adapter offering unprecedented, industry-leading performance, smart offloads and In-Network Computing, leading to the highest return on investment for Big Data, Machine Learning, Cloud, Web 2.0, and Storage applications

ConnectX-6 is a groundbreaking addition to the Mellanox ConnectX series of industry-leading adapters, providing two ports of 200GbE for Ethernet connectivity, sub 0.8usec latency and 215 million messages per second. With Mellanox Multi-Host™ support for up-to 8 independent hosts, an integrated PCIe switch, NVMe over Fabric and security offloads, ConnectX-6 offers the highest performance and most flexible solution for today's demanding data center applications. ConnectX-6 EN supports 200, 100, 50, 40, 25, and 10GbE Ethernet speeds.

### CLOUD AND WEB2.0 ENVIRONMENTS

Cloud, Web2.0 and Telecommunications customers build their data centers to maximize the performance and flexibility of applications running on the CPU. Software Defined Network (SDN) environments leverage the virtual switching capabilities of the operating systems to achieve maximum flexibility in network management and routing protocols. Open vSwitch (OVS) is an example of a virtual switch that allows virtual machines to communicate among themselves and with the outside world. Software-based virtual switches, traditionally residing in the hypervisor, are CPU intensive, affecting system performance and preventing full utilization of available CPU for compute functions.

With Mellanox Accelerated Switch and Packet Processing (ASAP<sup>2</sup>)<sup>®</sup> Direct technology, significantly higher vSwitch/vRouter performance is achieved without the associated CPU load. ConnectX-6 supports various vSwitch/vRouter offload functions including:

- Encapsulation and de-capsulation of overlay network headers
- Stateless offloads of inner packets,
- Packet headers re-write (enabling NAT functionality), hairpin, and more.

In addition, ConnectX-6 offers intelligent flexible pipeline capabilities, including programmable flexible parser and flexible match-action tables, which will enable hardware offloads of future protocols.

### HIGHLIGHTS

#### FEATURES

- Up to 200GbE connectivity per port
- Maximum bandwidth of 200Gb/s
- Up to 215 million messages/sec
- Sub 0.8usec latency
- Multi-Host with advanced quality of service (QoS) capabilities
- Block-level AES-XTS hardware encryption
- FIPS capable
- 8 network lanes support both 50G SerDes (PAM4)-and 25 SerDes (NRZ)-based ports
- Best-in-class packing with sub-nanosecond accuracy
- PCIe Gen4 and PCIe Gen3 support
- RoHS Compliant

#### BENEFITS

- Most intelligent, highest performance fabric for compute and storage infrastructures
- Cutting-edge performance in virtualized HPC networks including Network Function Virtualization (NFV)
- Advanced storage capabilities including block-level encryption and checksum offloads
- Host Chaining technology for economical rack design
- Smart interconnect for x86, Power, Arm, GPU and FPGA-based platforms
- Flexible programmable pipeline for new network flows
- Enabler for efficient service chaining
- Efficient I/O consolidation, lowering data center costs and complexity

## STORAGE ENVIRONMENTS

NVMe storage devices are gaining momentum, offering very fast access to storage media. The evolving NVMe over Fabric (NVMe-oF) protocol leverages RDMA connectivity to remotely access NVMe storage devices efficiently, while keeping the end-to-end NVMe model at lowest latency. With its NVMe-oF target and initiator offloads, ConnectX-6 brings further optimization to NVMe-oF, enhancing CPU utilization and scalability.

Additionally, as in previous ConnectX generations, ConnectX-6 enables Host Chaining, an innovative storage rack design by which different servers can be connected with no need for a switch.

## 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.



## SECURITY

ConnectX-6 block-level encryption offers a critical innovation to network security. As data in transit is stored or retrieved, it undergoes encryption and decryption. The ConnectX-6 hardware offloads the IEEE AES-XTS encryption/decryption from the CPU, saving latency and CPU utilization. It also guarantees protection for users sharing the same resources through the use of dedicated encryption keys.

By performing block-storage encryption in the adapter, ConnectX-6 excludes the need for self-encrypted disks. This allows customers the freedom to choose their preferred storage device, including byte-addressable and NVDIMM devices that traditionally do not provide encryption. Moreover, ConnectX-6 can support Federal Information Processing Standards (FIPS) compliance.

ConnectX-6 also includes a hardware Root-of-Trust (RoT), which uses HMAC relying on a device-unique key. This provides both a secure boot as well as cloning-protection. Delivering best-in-class device and firmware protection, ConnectX-6 also provides secured debugging capabilities, without the need for physical access.

## MACHINE LEARNING AND BIG DATA ENVIRONMENTS

Data analytics has become an essential function within many enterprise data centers, clouds and Hyperscale platforms. Machine learning relies on high throughput and low latency to train deep neural networks and to improve recognition and classification accuracy. ConnectX-6 is the perfect solution to provide machine learning applications with the levels of performance and scalability that they require.

ConnectX-6 utilizes the RDMA technology to deliver low-latency and high performance. ConnectX-6 enhances RDMA network capabilities even further by delivering RoCE Congestion Control, achieving end-to-end best performance.

## COMPATIBILITY

### PCI Express Interface

- PCIe Gen 4.0, 3.0, 2.0, 1.1 compatible
- 2.5, 5.0, 8, 16GT/s link rate
- 32 lanes as 2x 16-lanes of PCIe
- Support for PCIe x1, x2, x4, x8, and x16 configurations
- PCIe Atomic
- TLP (Transaction Layer Packet) Processing Hints (TPH)
- Embedded PCIe switch
- Advanced Error Reporting (AER)

- PCIe switch Downstream Port Containment (DPC) enablement for PCIe hot-plug
- Access Control Service (ACS) for peer-to-peer secure communication
- Process Address Space ID (PASID) Address Translation Services (ATS)
- IBM CAPIv2 (Coherent Accelerator Processor Interface)
- Support for MSI/MSI-X mechanisms

### Operating Systems/Distributions\*

- RHEL, SLES, Ubuntu and other major Linux distributions
- Windows
- FreeBSD
- VMware
- OpenFabrics Enterprise Distribution (OFED)
- OpenFabrics Windows Distribution (WinOF-2)

### Connectivity

- 50G SerDes (PAM4)-and 25 SerDes (NRZ)-based ports
- Interoperability with Ethernet switches (up to 200GbE)
- Passive copper cable with ESD protection
- Powered connectors for optical and active cable support

## FEATURES

### Ethernet

- 200GbE / 100GbE / 50GbE / 40GbE / 25GbE / 10GbE / 1GbE
- IEEE 802.3bj, 802.3bm 100 Gigabit Ethernet
- IEEE 802.3by, Ethernet Consortium 25, 50 Gigabit Ethernet, supporting all FEC modes
- 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
- 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
- Dynamically Connected transport (DCT)
- On demand paging (ODP)
- MPI Tag Matching
- Rendezvous protocol offload
- Out-of-order RDMA supporting Adaptive Routing

- Burst buffer offload
- In-Network Memory registration-free RDMA memory access

### CPU Offloads

- RDMA over Converged Ethernet (RoCE)
- TCP/UDP/IP stateless offload
- LSO, LRO, checksum offload
- RSS (also on encapsulated packet), TSS, HDS, VLAN and MPLS tag insertion/stripping, Receive flow steering
- Data Plane Development Kit (DPDK) for kernel bypass applications
- Open VSwitch (OVS) offload using ASAP<sup>2</sup>
- Flexible match-action flow tables
- Tunneling encapsulation / de-capsulation
- Intelligent interrupt coalescence
- Header rewrite supporting hardware offload of NAT router

### Storage Offloads

- Block-level encryption: XTS-AS 256/512 bit key
- NVMe over Fabric offloads for target machine
- Erasure Coding offload - offloading Reed-Solomon calculations
- T10 DIF - signature handover operation at wire speed, for ingress and egress traffic
- Storage protocols: SRP, iSER, NFS RDMA, SMB Direct, NVMeOF

### Multi-Host

- Independent PCIe interfaces to independent hosts
- Two PCIe x16 to two hosts, or four PCIe x8 to four hosts, or eight PCIe x4 to eight hosts
- Independent NC-SI SMBus interfaces
- Independent stand-by and wake-on-LAN signals
- Multi-Host Socket Direct – overcoming the QPI bottlenecks

### Overlay Networks

- RoCE over overlay networks
- Stateless offloads for overlay network tunneling protocols
- Hardware offload of encapsulation and decapsulation of VXLAN, NVGRE, and GENEVE overlay networks

### Hardware-Based I/O Virtualization

- Single Root IOV
- Address translation and protection
- VMware NetQueue support
- SR-IOV: Up to 512 Virtual Functions
- SR-IOV: Up to 16 Physical Functions per host
- Virtualization hierarchies (e.g., NPAR and Multi-Host)
- Virtualizing Physical Functions on a physical port
- SR-IOV on every Physical Function
- Configurable and user-programmable QoS
- Guaranteed QoS for VMs

### HPC Software Libraries

- HPC-X, OpenMPI, MVAPICH, MPICH, OpenSHMEM, PGAS and varied commercial packages

### Management and Control

- NC-SI, MCTP over SMBus and MCTP over PCIe - Baseboard Management Controller interface
- PLDM for Monitor and Control DSP0248
- PLDM for Firmware Update DSP026
- 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
- Unified Extensible Firmware Interface (UEFI)
- Pre-execution Environment (PXE)

\* 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	Ethernet Supported Speeds (GbE)	No. of Network Ports	Crypto	PCI Express Configuration
MT28908A0-NCCF-CE	100,50,40,25,10	2	No Crypto	PCIe 4.0/3.0 x 32
MT28908A0-CCCF-CE	100,50,40,25,10	2	Crypto	PCIe 4.0/3.0 x 32
MT28908A0-NCCF-VE	200, 100,50,40,25,10	2	No Crypto	PCIe 4.0/3.0 x 32
MT28908A0-CCCF-VE	200, 100,50,40,25,10	2	Crypto	PCIe 4.0/3.0 x 32