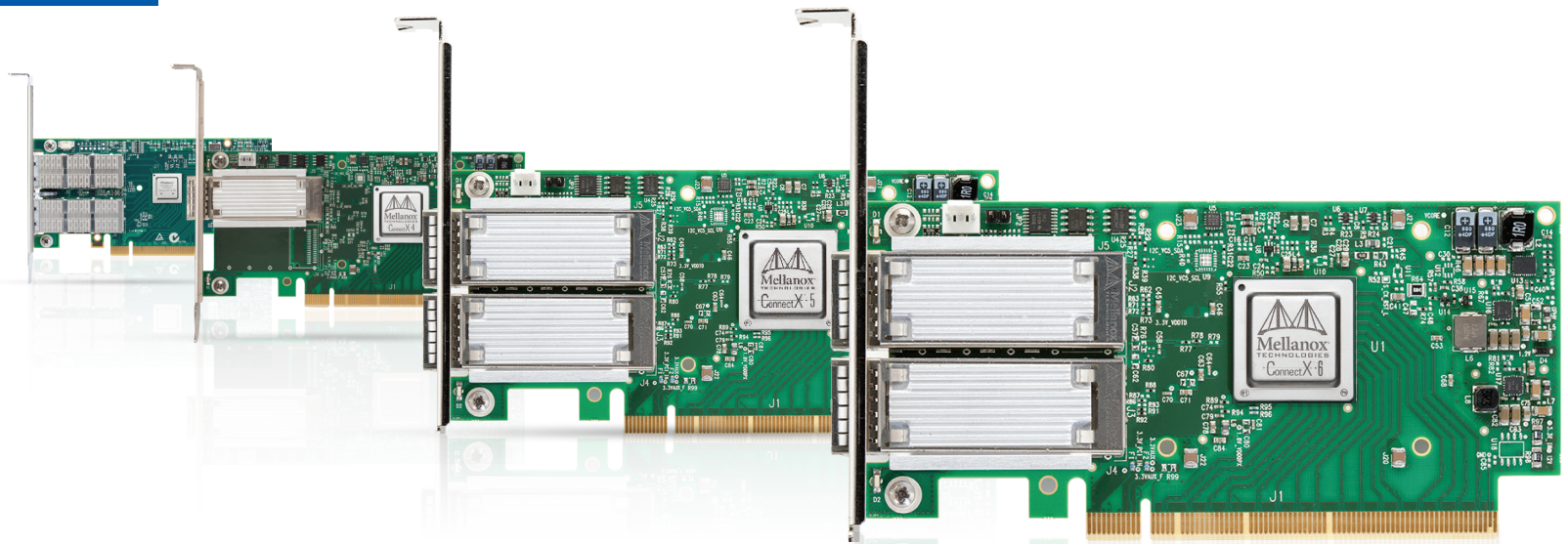
VPI / InfiniBand



Performance Accelerated

Mellanox InfiniBand Adapters Provide Advanced Data Center Performance, Efficiency and Scalability

Mellanox enables the highest data center performance with its **InfiniBand Host Channel Adapters (HCA)**, delivering state-of-the-art solutions for High-Performance Computing, Machine Learning, data analytics, database, cloud and storage platforms.

Mellanox InfiniBand Host Channel Adapters (HCA) provide the highest performing interconnect solution for High-Performance Computing, Enterprise Data Centers, Web 2.0, Cloud Computing, Machine Learning, and embedded environments. Clustered databases, parallelized applications, transactional services and high-performance embedded I/O applications will achieve significant performance improvements resulting in reduced completion time and lower cost per operation.

Mellanox delivers the most technologically advanced HCAs, providing best-in-class performance and efficiency. They are the ideal solution for HPC clusters that demand high bandwidth, high message rate and low latency to achieve the highest server efficiency and application productivity.

With traffic consolidation and hardware acceleration for virtualization, Mellanox HCAs provide optimal I/O services such as high bandwidth and server utilization to achieve the maximum return on investment (ROI) for data centers, high scale storage systems and cloud computing.

By offering Virtual Protocol Interconnect® (VPI), Mellanox HCAs offer the flexibility of connectivity for InfiniBand and Ethernet protocols within the same adapter.

World-Class Performance and Scale

Mellanox InfiniBand adapters deliver industry-leading bandwidth with ultra low-latency and efficient computing for performance-driven server and storage clustering applications. Network protocol processing and data movement overhead such as RDMA and Send/Receive semantics are completed in the adapter without CPU intervention. Application acceleration and GPU communication acceleration bring further levels of performance improvement. The advanced acceleration technology in Mellanox InfiniBand adapters enables higher cluster efficiency and large scalability to hundreds of thousands of nodes.

Complete End-to-End EDR InfiniBand Networking

ConnectX adapters are part of Mellanox's full EDR 100Gb/s InfiniBand end-to-end portfolio for data centers and high-performance computing systems, which includes switches, application acceleration packages, and cables. Mellanox's Switch-IB™ family of EDR InfiniBand switches and Unified Fabric Management software incorporate advanced tools that simplify networking management and installation, and provide the needed capabilities for the highest scalability and future growth. Mellanox's HPC-X™ collectives, messaging, and storage acceleration packages deliver additional capabilities for the ultimate server performance, and the line of EDR copper and fiber cables ensure the highest interconnect performance. With Mellanox end to end, IT managers can be assured of the highest performance and most efficient network fabric.

BENEFITS

World-class cluster performance
High-performance networking and storage access
Efficient use of compute resources
Guaranteed bandwidth and low-latency services
Smart interconnect for x86, Power, ARM, and GPU-based compute and storage platforms
Increased VM per server ratio
I/O unification
Virtualization acceleration
Scalability to hundreds-of-thousands of nodes

TARGET APPLICATIONS

High-performance parallelized computing
Data center virtualization
Public and private clouds
Machine Learning and data analysis platforms
Clustered database applications and high-throughput data warehousing
Latency-sensitive applications such as financial analysis and high frequency trading
Performance storage applications such as backup, restore, mirroring, etc.

Virtual Protocol Interconnect

VPI flexibility enables any standard networking, clustering, storage, and management protocol to seamlessly operate over any converged network leveraging a consolidated software stack. Each port can operate on InfiniBand or Ethernet fabrics, and supports IP over InfiniBand (IPoIB) and RDMA over Converged Ethernet (RoCE). VPI simplifies I/O system design and makes it easier for IT managers to deploy infrastructure that meets the challenges of a dynamic data center.

I/O Virtualization

Mellanox adapters provide comprehensive support for virtualized data centers with Single-Root I/O Virtualization (SR-IOV) allowing dedicated adapter resources and guaranteed isolation and protection for virtual machines (VM) within the server. I/O virtualization on InfiniBand gives data center managers better server utilization and LAN and SAN unification while reducing cost, power, and cable complexity.

Multi-Host Solution

Mellanox's Multi-Host® technology provides high flexibility and major savings in building next generation, scalable high-performance data centers. Multi-Host connects multiple compute or storage hosts into a single interconnect adapter, separating the adapter PCIe interface into multiple and independent PCIe interfaces with no performance degradation. The technology enables designing and building new scale-out heterogeneous compute and storage racks with direct connectivity between compute elements, storage elements and the network, better power and performance management, while achieving maximum data processing and data transfer at minimum capital and operational expenses.

Various Form Factors

Mellanox adapter cards are available in a variety of form factors to meet every data center's specific needs.

- Open Compute Project (OCP) cards integrate into the most cost-efficient, energy-efficient and scalable enterprise and Web 2.0 data centers, delivering leading connectivity for performance-driven server and storage applications. The OCP Mezzanine adapter form factor is designed to mate into OCP servers.
- Socket Direct™ cards enable EDR 100Gb/s transmission rates for servers without x16 PCIe slots. The adapter's 16-lane PCIe bus is split into two 8-lane buses, with one bus accessible through a PCIe x8 edge connector and the other bus through an x8 parallel connector to an Auxiliary PCIe Connection Card. With direct connectivity from each CPU to the network, the interconnect can bypass a QPI (UPI) and the other CPU, optimizing performance and reducing latecy for dual socket servers. Each CPU handles only its own traffic, improving CPU utilization. GPUDirect® RDMA is also enabled for all CPU/GPU pairs by ensuring that all GPUs are linked to CPUs close to the adapter card.

Storage Accelerated

A consolidated compute and storage network provides significant cost-performance advantages over multi-fabric networks. Standard block and file access protocols leveraging InfiniBand RDMA result in high-performance storage access. Adapters support SRP, iSER, NFS RDMA, SMB Direct, and SCSI and iSCSI storage protocols. ConnectX adapters also offer NVMe over Fabric offloads, a flexible Signature Handover mechanism based on the advanced T-10/DIF implementation, and Erasure Coding offloading capability enabling distributed RAID (Redundant Array of Inexpensive Disks).

Enabling High Performance Computing (HPC) Applications

Mellanox InfiniBand/VPI adapters, with advanced accelerations and RDMA capabilities, deliver best-in-class latency, bandwidth and message rate coupled with low CPU utilization, making them the most deployed adapters for large-scale HPC applications. Delivering the highest scalability, efficiency, and performance for HPC systems in a variety of markets and applications, including bioscience, media, automotive design, computational fluid dynamics and manufacturing, weather research and forecasting, and oil and gas industry modeling.

Software Support

All Mellanox adapters are supported by a full suite of drivers for Microsoft Windows, Linux and FreeBSD major distributions. The adapters support OpenFabrics-based RDMA protocols and software and are compatible with configuration and management tools from various OEMs and operating system vendors. The stateless offloads are fully interoperable with standard TCP/UDP/IP stacks.

ConnectX®-6

ConnectX-6 is the world's first 200Gb/s HDR InfiniBand and Ethernet network adapter card, offering world-leading performance, smart offloads and In-Network Computing. ConnectX-6 with VPI provides two ports of 200Gb/s InfiniBand and Ethernet connectivity supporting HDR, HDR100, EDR, FDR, QDR, DDR and SDR InfiniBand speeds, as well as 200, 100, 50, 40, 25, and 10Gb/s Ethernet speeds. Supports sub-600 nanosecond latency, an extremely high message rate, plus PCIe switch and NVMe over Fabric offloads, ConnectX-6 delivers the highest performance, secure and extremely flexible solution for the most demanding applications and markets. Includes Multi-Host support for up to 8 independent hosts and block-level encryption as a crucial innovation to network security, in addition to all of the features included in the earlier ConnectX adapters.

ConnectX®-5

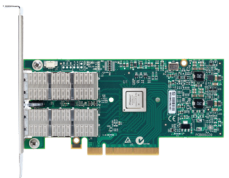
Intelligent ConnectX-5 adapter cards support Co-Design and In-Network computing, while introducing acceleration engines for maximizing HPC, data analytics and storage platforms. Supporting two ports of EDR 100Gb/s InfiniBand and 100Gb/s Ethernet connectivity, sub-600 nanosecond latency, a very high message rate, plus PCIe switch and NVMe over Fabric offloads. Includes new Message Passing Interface (MPI) offloads, e.g., MPI Tag Matching and MPI AlltoAll operations, advanced dynamic routing, and new data algorithms capabilities. Offers advanced application offloads supporting 100Gb/s for servers without x16 PCIe slots.

ConnectX®-4

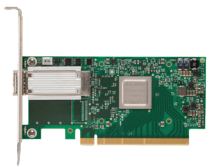
Mellanox ConnectX-4 adapter cards with VPI combine the flexibility of InfiniBand and Ethernet protocol connectivity within the same adapter, to support EDR 100Gb/s InfiniBand and 100Gb/s Ethernet connectivity. Enabling extremely high throughput and low latency, ConnectX-4 is a high performance and flexible solution for data analytics, Web access and storage platforms. Enabling efficient I/O consolidation, the ConnectX-4 adapter card significantly reduces data center costs and complexity.

ConnectX®-3 Pro

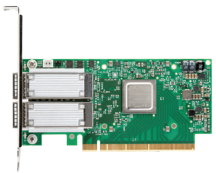
Mellanox's ConnectX-3 Pro Virtual Protocol Interconnect (VPI) adapter delivers high throughput across the PCI Express 3.0 host bus, by providing a FDR 56Gb/s InfiniBand and 40Gb Ethernet interconnect solution (up to 56GbE when connected to a Mellanox switch). Enabling fast transaction latency (less than 1usec), and delivery of more than 90M MPI messages/second, makes ConnectX®-3 Pro a highly-scalable, suitable solution for transaction-demanding applications.



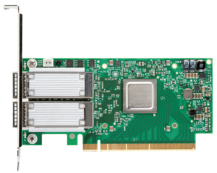
ConnectX-3 PRO



ConnectX-4

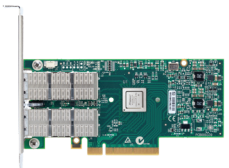


ConnectX-5

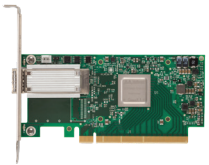


ConnectX-6

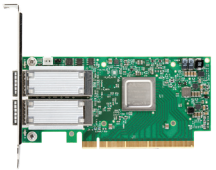
General Specs				
Ports	Single, Dual	Single, Dual	Single, Dual	Single, Dual
Port Speed (Gb/s)	IB: SDR, DDR, QDR, FDR10, FDR Eth: 10, 40, 56	IB: SDR, DDR, QDR, FDR, EDR Eth: 10, 25, 40, 50, 56, 100	IB: SDR, DDR, QDR, FDR, EDR Eth: 10, 25, 40, 50, 100	IB: SDR, DDR, QDR, FDR, EDR, HDR 200, HDR100 Eth: 10, 25, 40, 50, 100, 200
PCIe	Gen3 x8	Gen3 x8 Gen3 x16	Gen3 x16 Gen4 x16	Gen3 x16 / Gen4 x16 32 lanes as 2x 16-lane PCIe
Connectors	QSFP+	QSFP28	QSFP28	QSFP28
RDMA Message Rate (million msgs/sec)	36	150	200 (ConnectX-5 Ex, Gen4 server) 175 (ConnectX-5 En, Gen3 server)	200 (ConnectX-6 Ex, Gen4 server) 175 (ConnectX-6 En, Gen3 server)
Latency (us)	0.64	0.6	0.6	0.6
Typical Power (2 ports, max speed)	6.2W	13.8W	16.6W (ConnectX-5 Ex); 13.8W	TBD
RDMA	✓	✓	✓	✓
OOO RDMA (Adaptive Routing)			✓	✓
Dynamically Connected Transport		✓	✓	✓
Multi-Host		4 hosts	4 hosts	8 hosts
Storage				
NVMe-oF Target Offload			✓	✓
Erasure Coding (RAID Offload)			✓	✓
T-10 Dif/Signature Handover		✓	✓	✓



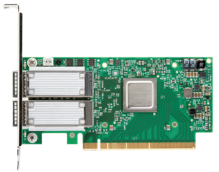
ConnectX-3 PRO



ConnectX-4



ConnectX-5



ConnectX-6

Virtualization				
SR-IOV	127 VFs	32 PFs, 254 VFs	64 PFs, 1000 VFs	64 PFs, 512 VFs
Congestion Control (QCN, ECN)	✓	✓	✓	✓
MPI Tag Matching Offload			✓	✓
OVS Offload		✓	✓	✓
VM Isolation and Protection			✓	✓
Security				
Block-level XTS-AES hardware encryption				✓
FIPS Compliance				✓
Management				
Hairpin (Host Chaining)			✓	✓
Host Management		✓	✓	✓
Multi-Host Isolation and Protection			✓	✓
QoS				
Packet Pacing		✓	✓	✓
Form Factors				
OCP	✓		✓	✓
Socket Direct			✓	✓

World-leading HPC centers are making the smart decision and choosing InfiniBand.

This is why:

Julich Supercomputer Centre

The Julich Supercomputer Centre chose HPC Testimonia for a balanced, Co-Design approach to its interconnect, providing low latency, high throughput, and future scalability to its cluster, which contributes to projects in the areas of energy, environment, and brain research.

> We chose a co-design approach, the appropriate hardware, and designed the system. This system was of course targeted at supporting in the best possible manner our key applications. The only interconnect that really could deliver that was HPC Testimonia.

CHPC South Africa

The Centre for High Performance Computing in South Africa, the largest HPC facility in Africa, chose HPC Testimonia to enhance and unlock the vast potential of its system, which provides high end computational resources to a broad range of users in fields such as bioinformatics, climate research, material sciences, and astronomy.

> The heartbeat of the cluster is the interconnect. Everything is about how all these processes shake hands and do their work. InfiniBand and the interconnect is, in my opinion, what defines HPC.

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 for feature availability.
*Product images may not include heat sync assembly; actual product may differ.

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