NVIDIA ConnectX®-6 Dx is a highly secure and advanced smart network interface card (SmartNIC) to accelerate mission-critical data center applications, such as security, virtualization, SDN/NFV, big data, machine learning, and storage. It provides up to two ports of 100Gb/s or a single-port of 200Gb/s Ethernet connectivity and the highest ROI of any SmartNIC.

ConnectX-6 Dx is powered by leading 50Gb/s (PAM4) and 25/10 Gb/s (NRZ) SerDes technology and novel capabilities that accelerate cloud and data center payloads.

ZERO-TRUST SECURITY

In an era where data privacy is key, ConnectX-6 Dx adapters offer advanced, built-in capabilities that bring security down to the endpoints with unprecedented performance and scalability:

- Crypto—IPsec and TLS data-in-motion inline encryption and decryption offload, and AES-XTS block-level, data-at-rest encryption and decryption offloads
- Probes and denial-of-service (DoS) attack protection—ConnectX-6 Dx enables a hardware-based L4 firewall by offloading stateful connection tracking through NVIDIA ASAP² - Accelerated Switch and Packet Processing® offload technology
- NIC security—Hardware root-of-trust (RoT) secure boot and secure firmware update using RSA cryptography, and cloning protection, via a device-unique secret key

ADVANCED VIRTUALIZATION

ConnectX-6 Dx enables building highly efficient virtualized cloud data centers:

- Virtualization—ASAP² delivers virtual switch (vSwitch) and virtual router (vRouter) hardware offloads at orders-of-magnitude higher performance than software-based solutions. ConnectX-6 Dx ASAP² offers both SR-IOV and VirtIO in-hardware offload capabilities and supports up to 8 million rules.
- Advanced quality of service (QoS)—ConnectX-6 Dx includes traffic shaping and classification-based data policing
INDUSTRY-LEADING ROCE

With industry-leading capabilities, ConnectX-6 Dx delivers more scalable, resilient, and easy-to-deploy remote direct-memory access over converged Ethernet (RoCE) solutions.

> Zero Touch RoCE (ZTR)—Simplifying RoCE deployments, ConnectX-6 Dx with ZTR allows RoCE payloads to run seamlessly on existing networks without special configuration, either to priority flow control (PFC) or explicit congestion notification (ECN). ConnectX-6 Dx ensures the resilience, efficiency, and scalability of deployments.

> Programmable congestion control—ConnectX-6 Dx includes an API for building user-defined congestion control algorithms for various environments running RoCE and background TCP/IP traffic concurrently.

BEST-IN-CLASS PTP FOR TIME SENSITIVE APPLICATIONS

NVIDIA offers a full IEEE 1588v2 Precision Time Protocol (PTP) software solution as well as time-sensitive-related features called 5T for 5G. NVIDIA PTP and 5T for 5G software solutions are designed to meet the most demanding PTP profiles. ConnectX-6 Dx incorporates an integrated PTP hardware clock (PHC) that allows the device to achieve sub-20 nanosecond (nsec) accuracy while offering timing-related functions, including time-triggered scheduling or time-based, software-defined networking (SDN) accelerations (time based ASAP²). 5T for 5G technology also enables software applications to transmit front-haul radio area network (RAN)-compatible data in high bandwidth. The PTP solution supports slave clock, master clock, and boundary clock operations.

ConnectX-6 Dx also supports SyncE, allowing selected ConnectX-6 Dx SmartNICs to provide PPS-Out or PPS-In signals from designated SMA connectors.

EFFICIENT STORAGE SOLUTIONS

With its NVMe-oF target and initiator offloads, ConnectX-6 Dx brings further optimization, enhancing CPU utilization and scalability. Additionally, ConnectX-6 Dx supports hardware offload for ingress and egress of T10-DIF/PI/CRC32/CRC64 signatures and AES-XTS encryption and decryption offloads, enabling user-based key management and a one-time Federal Information Processing Standards (FIPS) certification approach.

NIC PORTFOLIO

ConnectX-6 Dx SmartNICs are available in several form factors including low-profile PCIe, OCP2.0 and OCP3.0 cards, with various network connector types (SFP28/56, QSFP28/56, or DSFP). The ConnectX-6 Dx portfolio also provides options for NVIDIA Multi-Host® and NVIDIA Socket Direct® configurations.

ConnectX-6 Dx adds significant improvements to NVIDIA Multi-Host applications by offering advanced QoS features that ensure complete isolation among the multiple hosts connected to the NIC, and by achieving superior fairness among the hosts.

Solutions

> Cloud-native, Web 2.0, hyperscale
> Enterprise data centers
> Cybersecurity
> Big data analytics
> Scale-out compute and storage infrastructure
> Telco and network function virtualization (NFV)
> Cloud storage
> Machine learning and AI
> Media and entertainment
**FEATURES**

**Network Interface**
- 2 x 1/10/25/40/50/100 GbE; 1 x 200 GbE

**Host Interface**
- PCIe Gen 4.0, 3.0, 2.0, 1.1
- 16.0, 8.0, 5.0, 2.5 GT/s link rate
- 16 lanes of PCIe
- MSI/MSI-X mechanisms
- Advanced PCIe capabilities

**Virtualization/Cloud Native**
- Single Root IOV (SR-IOV) and VirtIO acceleration
- Up to 1K virtual functions per port
- 8 physical functions
- Support for tunneling
- Encap/decap of VXLAN, NVGRE, Geneve, and more
- Stateless offloads for overlay tunnels

**NVIDIA ASAP**
- SDN acceleration for:
  - Bare metal
  - Virtualization
  - Containers
- Full hardware offload for OVS data plane
- Flow update through RTE_Flow or TC_Flower
- OpenStack support
- Kubernetes support
- Rich classification engine (L2 to L4)
- Flex-parser: user defined classification
- Hardware offload for:
  - Connection tracking (L4 firewall)
  - NAT
  - Header rewrite
  - Mirroring
  - Sampling
  - Flow aging
  - Hierarchial QoS
  - Flow-based statistics

**Stateless Offloads**
- TCP/UDP/IP stateless offload
- LS0, LR0, checksum offload
- Receive side scaling (RSS) also on encapsulated packets
- Transmit side scaling (TSS)
- VLAN and MPLS tag insertion/stripping
- Receive flow steering

**Storage Offloads**
- Block-level encryption: XTS-AES 256/512-bit key
- NVMe over Fabric offloads for target machine
- T10 DIF - signature handover operation at wire speed, for ingress and egress traffic
- Storage protocols: SRP, iSER, NFS RDMA, SMB Direct, NVMe-oF

**Advanced Timing & Synchronization**
- Advanced PTP
- IEEE 1588v2 (any profile)
- PTP hardware clock (PHC) (UTC format)
- 20ns accuracy
- Line rate hardware timestamp (UTC format)
- PPS In and configurable PPS Out
- Time triggered scheduling
- PTP based packet pacing
- Time based SDN acceleration [ASAP®]
- Time sensitive networking (TSN)

**RDMA over Converged Ethernet (RoCE)**
- RoCE v1/v2
- Zero Touch RoCE: no ECN, no PFC
- RoCE over overlay networks
- IPsec over RoCE
- Selective repeat
- Programmable congestion control interface
- GPUDirect
- Dynamically connected transport (DCT)
- Burst buffer offload

**Management and Control**
- NC-SI, MCTP over SMBus and MCTP over PCIe - Baseboard Management Controller interface, NC51 over RBT in OCP 2.0/3.0 cards
- PLDM for Monitor and Control DSP0248
- PLDM for Firmware Update DSP026
- I²C interface for device control and configuration

**Remote Boot**
- Remote boot over Ethernet
- Remote boot over iSCSI
- UEFI support for x86 and Arm servers
- PXE boot

**STANDARDS**
- IEEE 802.3bs, 200 Gigabit Ethernet
- IEEE 802.3cd, 50, 100 and 200 Gigabit Ethernet
- IEEE 802.3bj, 802.3bm 100 Gigabit Ethernet
- IEEE 802.3by, 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 (supports only “Fast-Wake” mode)
- 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 802.1Qaz (ETS)
- IEEE 802.1Qbb (PFC)
- IEEE 802.1bg
- 25/50 Ethernet Consortium “Low Latency FEC” for 50GE/100GE/200GE PAM4 links
- PCI Express Gen3 and Gen4
## SMARTNIC PORTFOLIO & ORDERING INFORMATION

### OCP 3.0 SMALL FORM FACTOR

<table>
<thead>
<tr>
<th>Max Network Speed</th>
<th>Interface Type</th>
<th>Supported Ethernet Speeds [GbE]</th>
<th>Host Interface [PCIe]</th>
<th>Ordering Part Number (OPN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x 25GbE</td>
<td>SFP28</td>
<td>1/10/25</td>
<td>Gen4 x8</td>
<td>MCX621102AN-ADAT</td>
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<td>MCX621102AC-ADAT</td>
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<tr>
<td>2 x 50GbE</td>
<td>SFP56</td>
<td>1/10/25/50</td>
<td>Gen4 x16</td>
<td>MCX623102AN-ADAT</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>MCX623102AC-ADAT</td>
</tr>
<tr>
<td>1 x 100GbE</td>
<td>QSFP56</td>
<td>1/10/25/40/50/100</td>
<td>Gen4 x16</td>
<td>Contact NVIDIA</td>
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</tr>
<tr>
<td>2 x 100GbE</td>
<td>QSFP56</td>
<td>1/10/25/40/50/100</td>
<td>Gen4 x16</td>
<td>MCX623106AN-CDAT</td>
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<td></td>
<td>Gen4 x8 in a row,</td>
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<td></td>
<td>NVIDIA Socket Direct</td>
<td>Contact NVIDIA</td>
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<tr>
<td></td>
<td>QSFP56 + PPS</td>
<td>1/10/25/40/50/100</td>
<td>Gen4 x16</td>
<td>MCX623106PN-CDAT</td>
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<tr>
<td></td>
<td>In/Out SMAs</td>
<td></td>
<td></td>
<td>MCX623106PC-CDAT</td>
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<tr>
<td></td>
<td>DSFP</td>
<td>1/10/25/50/100</td>
<td>Gen4 x16</td>
<td>Contact NVIDIA</td>
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<td></td>
<td>Contact NVIDIA</td>
</tr>
<tr>
<td>1 x 200GbE</td>
<td>QSFP56</td>
<td>1/10/25/40/50/100/200</td>
<td>Gen4 x16</td>
<td>MCX623105AN-VDAT</td>
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<td>MCX623105AC-VDAT</td>
</tr>
</tbody>
</table>

1. Use Crypto enabled cards to utilize IPsec/TLS/AES-XTS encryption/decryption hardware offload.
2. 50G can be supported as either 2x25G NRZ or 1x50G PAM4 when using QSFP56.
3. 100G can be supported as either 4x25G NRZ or 2x50G PAM4 when using QSFP56.

By default, the above products are shipped with a tall bracket mounted; a short bracket is included as an accessory.

### OCP 2.0 FORM FACTOR

<table>
<thead>
<tr>
<th>Max Network Speed</th>
<th>Interface Type</th>
<th>Supported Ethernet Speeds [GbE]</th>
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<tr>
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<td>MCX623432AC-ADAB</td>
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<tr>
<td>2 x 50GbE</td>
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<td>1/10/25/50</td>
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<td>MCX623432AC-GDAB</td>
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<tr>
<td>1 x 100GbE</td>
<td>QSFP56</td>
<td>1/10/25/40/50/100</td>
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<td>2 x 100GbE</td>
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<td>Gen4 x16 Multi-Host</td>
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<td>DSFP</td>
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These OPNs are single host; contact NVIDIA for OCP OPNs with NVIDIA Multi-Host support. The above OCP 3.0 OPNs come with thumbscrew (pull tab) brackets; contact NVIDIA for additional bracket types, such as Internal Lock or Ejector latch.

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