

# NVIDIA® Mellanox® BlueField® SmartNIC for Ethernet

## High Performance Ethernet Network Adapter Cards

Combining Arm® processing power with advanced network and storage offloads to accelerate a multitude of security, networking and storage applications with world-leading performance, flexibility and efficiency.

BlueField SmartNIC features the BlueField Data Processing Unit (DPU) — an innovative and high-performance programmable networking engine. Providing unmatched scalability and efficiency, the dual-port BlueField SmartNIC is the ideal adapter to accelerate the most demanding workloads in data center, cloud, service provider and storage environments. BlueField SmartNICs come in different speeds, numbers of CPU cores and PCIe widths—from dual-port 25GbE PCIe Gen4 x8 to dual-port 100GbE PCIe Gen4 x16, supporting 4/8/16 Arm cores.

### Powerful & Smart Network Adapter

BlueField SmartNIC adapters accelerate a wide range of applications through flexible data and control plane offloading. Enabling a more efficient use of compute resources, BlueField adapters empower the CPU to focus on running applications rather than on networking or security processing. Additionally, as software-defined adapters, BlueField SmartNICs ensure the ultimate flexibility by adapting to future protocols and features through simple software updates.

### BlueField System-on-Chip

BlueField is a Mellanox family of advanced solutions that integrates a coherent mesh of 64-bit Armv8 A72 cores, a ConnectX network adapter front-end and a PCI Express switch into a single chip.

The powerful DPU architecture includes a 64-bit Armv8 multicore processor array and enables customers to develop sophisticated applications and highly differentiated feature sets. BlueField leverages the rich Arm software ecosystem and introduces the ability to offload the x86 software stack.

At the heart of BlueField is the ConnectX-5 network controller with DMA over Converged Ethernet (RoCE) and InfiniBand offload technology, which delivers cutting-edge performance for networking and storage applications such as NVMe over Fabrics. Advanced features include an embedded virtual switch with programmable access lists (ACLs), transport offloads and stateless protocols.

## HIGHLIGHTS

- Intelligent programmable network adapter
- Best-in-class hardware offloads with Arm processing power
- Accelerates a wide range of security, networking, storage and other workloads
- Dedicated hardware offload for NVMe-over-Fabrics (NVMe-oF)
- Dual-port 25GbE PCIe Gen4.0 x8
- Dual-port 100GbE PCIe Gen4.0 x16
- 8 or 16 Arm A72 cores, depending upon model
- 4/8/16GB on-board DDR4 memory, depending upon model
- Various form factors
- Standard embedded Linux software stack
- Hardware-based security isolation

## Security Applications

BlueField SmartNIC addresses the concerns of modern data centers by combining hardware encryption accelerators with embedded software and fully integrated advanced network capabilities, making it an ideal platform for developing proprietary security applications.

It enables a distributed security architecture by isolating and protecting each individual workload and providing flexible control and visibility at the server and workload level, controlling risk at the server access layer. BlueField builds security into the DNA of the data center and enables prevention, detection and response to potential threats in real time.

BlueField SmartNIC is capable of delivering powerful functionality, including encryption of data-in-motion, bare metal provisioning, stateful L4 firewall and more.

## Networking Applications

BlueField SmartNIC offers a wide range of dedicated offloads to maximize virtualization scalability and efficiency. Data center administrators can benefit from better server utilization, allowing more virtual machines and more tenants on the same hardware, while reducing the TCO, power, and cable complexity.

Among its accelerations:

- Mellanox ASAP<sup>2</sup> - Accelerated Switching and Packet Processing<sup>®</sup> for Open vSwitch (OVS) delivers flexible, highly efficient virtual switching and routing capabilities. OVS accelerations can be further enhanced using BlueField processing and memory. For example, the scale of OVS actions can be increased by utilizing BlueField internal memory, and more OVS actions and vSwitch/vRouter implementations can be supported.
- Network overlay technology (VXLAN, NVGRE, Geneve) offload, including encapsulation and decapsulation, allows the traditional offloads to operate on the tunneled protocols and also offload Network Address Translation (NAT) routing capabilities.

## Storage Applications

BlueField SmartNIC may operate as a co-processor offloading specific storage tasks from the host, isolating part of the storage media from the host, or enabling abstraction of software-defined storage logic, using both a BlueField-dedicated hardware offload for NVMe-over-Fabrics and Arm cores.

On the storage initiator side, BlueField SmartNICs can prove an efficient solution for hyperconverged systems to enable the host CPU to focus on compute while all the storage and networking tasks are handled through the NIC engine and Arm cores.

Decoupling of the storage tasks from the compute tasks also simplifies the software model, enabling the deployment of multiple OS virtual machines while the storage application is handled solely by the Arm Linux subsystem.

## Mellanox NVMe SNAP<sup>™</sup>

NVMe SNAP (Software-defined Network Accelerated Processing) enables hardware virtualization of NVMe storage. The Mellanox NVMe SNAP framework enables customers to easily integrate networked storage solutions into their cloud or enterprise server deployments. NVMe SNAP brings virtualized storage to bare-metal clouds and makes composable storage simple, promoting CAPEX and OPEX savings. It enables the efficient disaggregation of compute and storage to allow fully-optimized resource utilization.

NVMe SNAP logically presents networked storage as a local NVMe drive on the PCIe bus to host software. This allows the host OS/Hypervisor to use a standard NVMe-driver instead of different network storage protocols.

NVMe SNAP empowers customers with the freedom to implement their own storage technology and solutions on top of the NVMe SNAP framework that runs on Mellanox BlueField<sup>™</sup> embedded Arm cores along with embedded hardware storage acceleration engines. This powerful combination is agile yet completely transparent to host software, allowing NVMe SNAP to be integrated into almost any storage solution.

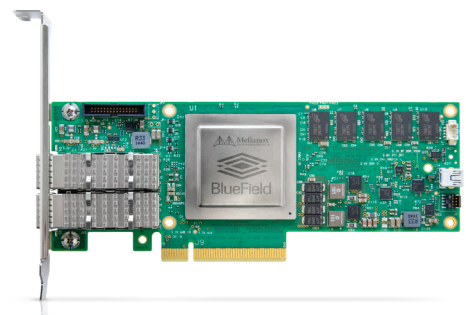
NVMe SNAP is a licensed software available on select BlueField part numbers, see Table 1 and Table 2 for more information.

## Software Support

BlueField SmartNIC is shipped with Mellanox BlueOS<sup>®</sup> but other operating systems, such as RH xx.xx and others, are also supported. BlueOS is a Linux reference distribution, which includes the Mellanox OFED stack, and is capable of running all customer-based Linux applications seamlessly. BlueOS itself is based on the Yocto Project Poky distribution. A PXE driver is also pre-installed.

The BlueField adapter execution environment is fully isolated from the x86 server and network environment, and can run the Open vSwitch Database (OVSDb) or other virtual switches to create a secure solution for bare metal provisioning.

The software package also includes support for DPDK, and applications for encryption and a stateful L4-based firewall.



## Features

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

### NETWORK AND HOST INTERFACES

#### Network Interfaces

- Dual-port SFP28 or two QSFP28 Ethernet ports
- Integrated PHYs seamlessly connect to all standard copper and fiber media

#### PCI Express Interface

- 8 or 16 lanes of PCIe Gen 3.0/4.0
- Fall-back to 4, 2, or 1 lane

### ARM/DDR SUBSYSTEM

#### Arm Cores

- Armv8 A72 cores (64-bit)
- Superscalar, variable-length, out-of-order pipeline
- Each core supports NEON™ 128b SIMD execution unit
- Arm VFPv4 single and double precision floating point acceleration (IEEE 754)
- Per core 48KB I-cache and 32KB D-cache
- Cache coherent mesh interconnect of CPUs, I/O and memory – each tile contains 2 cores and 1 MB L2 cache
- 6 MB L3 cache, sophisticated eviction policies

#### On-board Memory

- Single channel 4/8/16GB DDR4 DRAM with ECC

### HARDWARE ACCELERATIONS

#### Encryption Acceleration

- Armv8 cryptography extensions: A64, A32, and T32 instructions for:
  - AES, SHA-1, SHA-224, and SHA-256
  - Finite field arithmetic used in algorithms such as Galois/Counter Mode and Elliptic Curve
- Hardware Public Key Accelerator
  - RSA, Diffie-Hellman, DSA, ECC, EC-DSA, EC-DH
- True Random Number Generator with entropy source

#### Enhanced Features

- PeerDirect RDMA (aka GPUDirect) communication acceleration
- Enhanced Atomic operations
- Registration-free RDMA memory access
- NVMe-over-Fabric hardware acceleration

#### Transport Offloads

- RDMA over Converged Ethernet (RoCE)
- TCP/UDP/IP stateless offload
- LSO, LRO, checksum offload
- RSS (also on encapsulated packets), TSS, HDS, VLAN insertion/stripping, Receive Flow Steering
- Intelligent interrupt coalescence
- TCP/UDP, MPLS, VxLAN, NVGRE, GENEVE
- SRP, iSER, NFS RDMA, SMB Direct, NVMe-oF

#### Hardware-based I/O Virtualization

- SR-IOV
- Multi-function per port
- Multiple queues per virtual machine

#### Management and Control

- SDN management interface for managing the eSwitch
- eMMC memory controllers

### SOFTWARE DEVELOPMENT TOOLCHAIN

- Native and cross-compile GNU toolchain
- Performance analysis and profiling tools
- Compatible with Arm DS-5 and other commercial development and profiling tools

### SOFTWARE SUPPORT

#### Arm Environment

- BlueOS: Commercial grade Yocto-based Arm Linux distribution
- Commercial Linux distributions supported
- Delivered with OpenFabrics Enterprise Distribution (OFED)
- Arm-optimized versions of all Mellanox drivers and software stack
- Accelerated NVMe over Fabrics target stack
- Optimized Arm DPDK and ConnectX PMD
- NVMe SNAP framework (license required)

#### Connected Host (Network Adapter Environment)

- Linux
- Windows
- FreeBSD
- VMware
- OpenFabrics Enterprise Distribution (OFED)
- OpenFabrics Windows Distribution (WinOF-2)

Table 1 - Part Numbers and Feature Set Breakdown

OPN	Max. Speed	No. of Ports	PCIe Support	Cores	NVMe SNAP™	Crypto*	DDR Memory	Form Factor
MBF1M332A-ASNAT	25GbE	2 x SFP28	Gen3.0/4.0 x8	G-Series 16 Cores	Optional License (Table 2)	Crypto disabled	16GB on-board	HHHL Tall Bracket
MBF1M332A-ASCAT	25GbE	2 x SFP28	Gen3.0/4.0 x8			Crypto enabled	16GB on-board	
MBF1M322A-ASNAT	25GbE	2 x SFP28	Gen3.0/4.0 x8			Crypto disabled	8GB on-board	FHHL Tall Bracket
MBF1L516A-CSNAT	100GbE	2 x QSFP28	Gen3.0/4.0 x16			Crypto enabled	16GB on-board	
MBF1L516A-CSCAT	100GbE	2 x QSFP28	Gen3.0/4.0 x16	G-Series 8 Cores	--	Crypto disabled	16GB on-board	HHHL Tall Bracket
MBF1M332A-AENAT	25GbE	2 x SFP28	Gen3.0/4.0 x8			Crypto enabled	16GB on-board	
MBF1M332A-AECAT	25GbE	2 x SFP28	Gen3.0/4.0 x8					

\* Note: Secure boot is not supported on these SmartNIC models, please contact Mellanox for additional information.

Table 2 - NVMe SNAP License (sold separately)

OPN	Description
BF1-NVMESNAP-BNS-1	One perpetual license to use NVMe SNAP on one BlueField adapter. Includes Mellanox Technical Support and Warranty - Silver, 1 Year.

### Support

For information about Mellanox support packages, please contact your Mellanox Technologies sales representative or visit our [Support Index page](#).