Mellanox BlueField™ SmartNIC

Smart programmable network adapter card combines ARM® processing power with advanced network offloads to accelerate a multitude of security, networking and storage applications, delivering world-leading performance, flexibility and efficiency.

BlueField SmartNIC is a two-port 25Gb/s network adapter featuring the BlueField system-on-chip (SoC), which integrates the ConnectX®-5 network controller with an ARM multicore processor array, to deliver an innovative and high-performance programmable networking engine. Providing unmatched scalability and efficiency, the BlueField SmartNIC is the ideal adapter to accelerate the most demanding workloads in data center, cloud, service provider and storage environments.

POWERFUL SMART NETWORK ADAPTER

The BlueField SmartNIC is an 8-lane PCIe Gen3.0/4.0, half-height, half-length (HHHL) card comprising two 25Gb/s Ethernet SFP28 ports and a BlueField SoC with a DDR4 DRAM memory subsystem. This powerful network adapter offers the flexibility to fully, or partially, implement and offload the data and control planes to accelerate a range of applications.

The BlueField adapter enables a more efficient use of compute resources, now dedicated to run applications rather than focus on networking or security processing, therefore supporting the growing demand for bandwidth per host. This software-defined adapter ensures ultimate flexibility by adapting to future protocols and features through simple software update.

BLUEFIELD SYSTEM-ON-CHIP

BlueField is a Mellanox family of advanced SoC 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 SoC architecture includes an 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 offload controller with RDMA and RDMA over Converged Ethernet (RoCE) technology, delivering 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 encaps/decaps of NVGRE, VXLAN, and MPLS overlay protocols.

HIGHLIGHTS

- Intelligent programmable network adapter
- Combines best-in-class hardware network offloads with ARM processing power
- Accelerates wide range of security, networking, storage and other workloads
- Reduces TCO by offloading main CPU to focus on compute and applications rather than security or networking functions
- 2 ports of 25GbE, 8x lanes of PCIe 3.0 and 4.0
- Standard embedded Linux software stack
- Accelerates a range of workloads
- Open vSwitch (OVS) including custom implementation and extensions
- Implementation of various types of security functions, such as:
  - Stateful L4-based firewall
  - Encryption of data in motion
- Storage accelerations, leveraging hardware offloads for NVMe-oF
FOR 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.

FOR 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 Accelerated Switching and Packet Processing for OpenvSwitch (ASAP™ for 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.

- BlueField PCIe SR-IOV technology provides dedicated adapter resources and guaranteed isolation and protection for virtual machines within the server.

- Pipeline-based, programmable, embedded switch (eSwitch), as well as hairpin hardware capability, guarantees data handling by a virtual appliance with minimal server CPU intervention.

- 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.

FOR 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 the BlueField ARM cores.

On the storage initiator side, BlueField SmartNIC can prove an efficient solution for hyperconverged systems to enable the host CPU to focus on compute while all the storage interface is handled through the 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.

SOFTWARE SUPPORT

BlueField SmartNIC is shipped with Mellanox BlueOS™ and a PXE driver pre-installed. BlueOS is a Linux reference distribution, which includes the Mellanox OFED stack, and is capable of running all customer-based Linux applications seamlessly. Note that BlueOS itself is based on the Yocto Project Poky distribution.

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.
Network Interfaces
- Two SFP28 Ethernet ports, 25Gb/s
- Integrated PHYs seamlessly connect to all standard copper and fiber media

PCIe Interface
- Eight-lane PCIe Gen 3.0/4.0
- Fall-back to 4, 2, or 1 lane

Powerful ARM Processor 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
- One-channel DDR4 DRAM with ECC

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 and 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

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

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 NVMé over Fabrics target stack
- Optimized ARM DPDK and ConnectX PMD

Connected Host (Network Adapter Environment)
- Linux
- Windows®
- FreeBSD
- VMware
- OpenFabrics Enterprise Distribution (OFED)
- OpenFabrics Windows Distribution (WinOF-2)

Table 1 - Part Numbers and Descriptions

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<thead>
<tr>
<th>OPN</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>MBF1M332A-AENAT</td>
<td>Dual-port SFP28 @ 25Gb/s Ethernet NIC, 8 core BlueField SoC, PCIe Gen4.0 x8, HHHL single-slot form factor</td>
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<tr>
<td>MBF1M332A-AECAT</td>
<td>Dual-port SFP28 @ 25Gb/s Ethernet NIC, 8 core BlueField SoC with crypto capabilities, PCIe Gen4.0 x8, HHHL single-slot form factor</td>
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Support
For information about Mellanox support packages, please contact your Mellanox Technologies sales representative or visit our Support Index page.