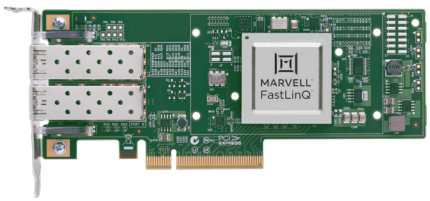
Marvell® FastLinQ® 41000 Series

Multiport 10/25Gb Converged Network Adapters with Universal RDMA for Dell®



- iSCSI-Offload and FCoE-Offload support
- Dual and quad port 10GbE, and dual 25GbE CNA options
- Delivers full line-rate 10/25GbE performance with dual and quad 10Gb ports
- Universal RDMA—Delivers the choice and flexibility with concurrent support for RoCE, RoCEv2, and iWARP technologies
- Secure firmware update process with private/public key encryption technology protects against rogue firmware.
- Enables provisioning of multiple QoS backed Ethernet functions for greater deployment flexibility through switch-independent NIC partitioning
- Boosts host CPU efficiency with hardware offloads for GRE, NVGRE, GENEVE, and VXLAN tunnels
- 10GBASE-T version provides low-cost and easy-to-install RJ45 connectivity that is compatible with existing 1GbE

The FastLinQ 41000 Series Converged Network Adapter (CNA) with Universal Remote Direct Memory Access (RDMA)—available in 10GBASE-T (RJ45), 10-Gigabit Ethernet (GbE) SFP+, and 25GbE SFP28—supports LAN (TCP/IP) traffic at 10/25GbE line-rate speeds. The 41000 Series provides extremely low host CPU usage by enabling full stateless offloads to meet the performance requirements of the most demanding enterprise applications.

The FastLinQ 41000 Series leverages Marvell's 15+ years of expertise in Ethernet by providing the highest levels of performance, efficiency, and scalability for the enterprise data center.

For more effective use of the 10/25GbE bandwidth, the 41000 Series Converged Network Adapter offers switch-independent NIC partitioning (NPAR), which enables segmentation of a single 10/25GbE port into multiple network partitions and dynamic allocation of bandwidth to each port. The segmentation allows IT organizations to optimize resources while lowering infrastructure and operational costs.

The evolution of data centers—triggered by high-density server virtualization, software-defined networking (SDN), and multitenant cloud computing platforms—demands a high-performance 10/25GbE solution that boosts CPU efficiency and reduces capital expenditures (CAPEX) and operational expenditures (OPEX) of the migration to 10/25GbE. The FastLinQ 41000 Series Adapters are the best choice for workload-intensive computing environments, providing reliable, high-performance 10/25GbE connectivity solutions.

FEATURES

- Universal RDMA technologies—RDMA over Converged Ethernet (RoCE), RoCEv2, and iWARP
- PCI Express® (PCIe®) Gen 3 x8 (8GT/s) support
- Full line-rate performance across dual and quad ports
- Broad operating system (OS) and hypervisor support
- iSCSI-Offload and FCoE-Offload support
- Network boot support
  - iSCSI remote boot
  - FCoE remote boot from LUN
  - Preboot Execution Environment (PXE) 2.0
  - Unified Extensible Firmware Interface (UEFI) support
- Simplifies deployment and troubleshooting using Windows® Admin Center, QLogic® Control Suite (QCS) CLI, QConvergeConsole® (QCC) PowerKit, UEFI human interface infrastructure (HII), in-OS utilities, QCC vCenter GUI and ESXCLI Plug-ins, and OpenStack® integration

- Switch-independent NPAR with up to 16 physical functions (partitions) per adapter
- Marvell Data Plane Development Kit (DPDK) high-speed packet processing engine delivers up to 38 million packets per second at 64B frame sizes
- Energy Efficient Ethernet (EEE) support for reduced idle power consumption in RJ-45-based networks (10GBASE-T variants only)
- MSI and MSI-X support
- IPv4 and IPv6 stateless offloads
- PCI-SIG® single root input/output virtualization (SR-IOV) with up to 192 virtual functions
- Comprehensive stateless offloads (see page 6)
- Auto negotiation: 1G/10G (BASE-T) and 10G/25G (on direct attach cable (DAC) cable using 10GBASE-KR/25GBASE-CR)
- FastLinQ SmartAN™ for intelligent connectivity that determines link speed, cable type and length, and Forward Error Correction requirements.
- RX/TX multiqueue
  - VMware® NetQueue
  - Windows® Hyper-V® Virtual Machine Queue
  - Linux Multiqueue
- Tunneling offloads
  - Windows Network Virtualization using Generic Routing Encapsulation (NVGRE)
  - Linux Generic Routing Encapsulation (GRE)
  - VMware, Windows, and Linux Virtual Extensible LAN (VXLAN)
  - Linux and VMware Generic Network Virtualization Encapsulation (GENEVE)
- Receive side scaling (RSS)
- Transmit side scaling (TSS)
- Support for virtual LAN (vLAN) tagging
- Support for jumbo frames larger than 1,500 bytes (up to 9,600 bytes)
- Network teaming, failover, and load balancing
  - Switch independent NIC teaming/ bonding
  - Switch dependent NIC teaming/ bonding such as link aggregation control protocol (LACP) and generic trunking
- Data center bridging (DCB)
  - Data center bridging capability exchange protocol (DCBX) link layer discovery protocol (LLDP)
  - Priority-based flow control (PFC)
  - Traffic Class over VLAN's 3-bit priority code point (PCP) field or Traffic Class over the IP header's 3-bit differentiated services code point (DSCP) field
  - Enhanced Transmission Selection (ETS)
  - Explicit Congestion Notification (ECN or CN)
  - Data Center Quantized Congestion Notification (DCQCN)
- Non-offloaded Storage over Ethernet
  - iSCSI using OS-based software initiators
- Offloaded storage over Ethernet
  - Increases server performance with full hardware offload for storage traffic
  - Industry-leading FCoE-Offload performance of up to 3.6 million IOPS, suitable for high-density server virtualization and large databases
  - Industry-leading iSCSI-Offload performance of up to 2.9 million IOPS, suitable for a diverse set of applications leveraging the flexibility of iSCSI
- Marvell Flow Filtering is supported on Linux® using the `ethtool -u/-U` commands. See the n-tuple Flow Filtering and Steering FastLinQ 41000/45000 Series Adapters Deployment Guide for more information.

Accelerate Any Network With Universal RDMA Offload

The FastLinQ 41000 Series Adapters support RoCE and iWARP RDMA protocols to deliver low latency, low CPU utilization and high performance on Windows, VMware, and Linux operating systems. 41000 Series Adapters have the unique capability to deliver Universal RDMA that enables RoCE, RoCEv2, and iWARP. Marvell Universal RDMA provides the ultimate flexibility in accelerating use cases like Microsoft Storage Spaces Direct (S2D), Windows Live Migration, Windows SMB Direct, Linux/Windows VF RDMA, VMware PVRDMA, NVMe™ over Fabrics (NVMe-oF), CEPHS and NFS over RDMA, and so on. Marvell's cutting-edge offloading technology increases cluster efficiency and scalability to many thousands of nodes for HyperConverged infrastructure deployments. Customers looking to scale out NVMe-oF can leverage the 41000 Series capabilities of supporting NVMe-oF over TCP (NVMe/TCP) in addition to RDMA transports.

Benefits

Simplified Migration to 10/25GbE

FastLinQ 41000 Series Adapters feature a high-speed, flexible architecture and switch-independent NPAR technology. Designed for both physical and virtual environments, this switch-agnostic approach enables administrators to split up the 10/25GbE network pipe to divide and reallocate bandwidth and resources, as needed, at the adapter level.

- Customers deploying rack and tower servers with multiple GbE adapters can greatly benefit from consolidating multiple network adapters and freeing up PCI slots for other add-in card upgrades.
- With NPAR, 41000 Series Adapters can further partition their network bandwidth into multiple virtual connections, making 1 adapter appear as 16 adapters to the OS for use by the applications.
- NPAR greatly simplifies the physical connectivity to the server, reduces implementation time, and lowers the acquisition cost of 10/25GbE migration.
- Available in 10GBASE-T, SR and LR optics, direct-attach copper (DAC) cables, and active optical cables (AOC), 41000 Series Adapters are the ideal choice for migrating multiple 1GbE network connections to consolidated 10/25GbE.
- Marvell 41000 Series Converged Network Adapters (CNAs) deliver converge storage and networking I/O by deploying OS-based software iSCSI initiators and a fully offloaded iSCSI and Fibre Channel over Ethernet (FCoE) solution that conserves CPU resources and delivers maximum performance over their 10BASE-T and 10G/25G optical or DAC connections.

Designed for Next-gen Server Virtualization

The FastLinQ 41000 Series Adapters support today's most compelling set of powerful networking virtualization features: SR-IOV, NPAR, tunneling offloads (VXLAN, GRE, GENEVE, and NVGRE), and industry-leading performance, thus enhancing the underlying server virtualization features.

- SR-IOV delivers higher performance and lower CPU use with increased virtual machine (VM) scalability.

- Marvell NPAR enables up to 16 physical, switch-agnostic, switch-independent NIC partitions per adapter. Dynamic and fine-grained bandwidth provisioning enables control of network traffic from VMs and hypervisor services.
- Concurrent support for SR-IOV and NPAR enables virtual environments with the choice and flexibility to create an agile virtual server platform.
- Availability of both RSS and TSS allows for more efficient load balancing across multiple CPU cores.

High-Performance Multitenancy Delivered

As large-scale private and public cloud deployment requirements for isolation and security stretch the boundaries of traditional vLANs, the FastLinQ 41000 Series Adapters deliver network virtualization features for high-performance overlay networks.

- Designed to meet the demands of large, public cloud deployments, the 41000 Series Adapters feature tunneling offloads for multitenancy with VXLAN, GRE, GENEVE, and NVGRE support.
- Line-rate 10/25GbE performance across individual ports in multitenant deployments maximizes server-processing performance by delivering an offloaded Ethernet adapter for enterprise, telco, and cloud deployments on Microsoft® Windows Server®, VMware vSphere®, and various Linux distributions.

Simplified Management

Marvell's QConvergeConsole (QCC) provides vCenter GUI, ESXCLI Plug-ins, and OpenStack integration.

QLogic Control Suite (QCS) CLI is available for locally and remotely managing Linux and Windows servers. QCC PowerKit is available for remotely managing Linux, VMware (PowerCLI), and Windows servers. Additionally, pre-boot UEFI HII system BIOS device configuration is available on servers that support UEFI HII.

Accelerate Telco Network Function Virtualization (NFV) Workloads

In addition to OpenStack, the FastLinQ 41000 Series Adapters support NFV, which allows decoupling network functions and services from dedicated hardware (such as routers, firewalls, and load balancers) into hosted VMs. NFV enables network administrators to flexibly create network functions and services as they need them, reducing capital expenditure and operating expenses, and enhancing business and network services agility. Marvell technology is integrated into the DPDK and can deliver up to 38 million packets per second to host the most demanding NFV workloads.

Also, the FastLinQ 41000 Series Adapters support the NSX-T/N-VDS Enhanced data path/Network Stack (ENS) polling mode driver (QeDeNTV_ens) for NFV workloads on VMware ESXi 6.7.

Trusted, Secure, Reliable, and Interoperable

The FastLinQ 41000 Series 10/25GbE Adapters adhere to standards that ensure interoperability with a wide range of network solutions. Marvell adapters are secure by design. Through public and private key encryption technology, the adapters enforce a process for secure firmware updates that prevent hackers from altering the code running on the adapters.

Host Bus Interface

Bus Interface

- PCI Express (PCIe) Gen 3 x8 (x8 physical connector)
- Supports PCIe upconfigure to reduce link width to conserve power

Host Interrupts

- MSI-X supports independent queues

I/O Virtualization and Multitenancy

- SR-IOV (up to 192 virtual functions)
- Switch-independent NPAR (up to 16 physical functions)
- GRE and NVGRE packet encapsulation offloads
- VXLAN packet encapsulation offloads
- GENEVE packet encapsulation offloads

Compliance

- *PCI Base Specification*, rev. 3.1
- *PCI Express Card Electromechanical Specification*, rev. 3.0
- *PCI Bus Power Management Interface Specification*, rev. 1.2
- *Advanced configuration and power interface (ACPI)* v2.0

Ethernet

Throughput

- 10/25Gbps line rate for single and dual port
- Auto negotiation: 1G/10G (BASE-T) and 10G/25G (on DAC cable using 10GBASE-KR/25GBASE-CR)

Ethernet Frame

- 1,500 bytes and larger (jumbo frame)

Stateless Offload

- TCP segmentation offload (TSO)
- Large send offload (LSO)
- VMware large receive offload (LRO)
- Linux generic receive offload (GRO)
- Generic segmentation offload (GSO)
- TCP and user datagram protocol (UDP) checksum offloads
- Receive segment coalescing (RSC)
- Interrupt coalescing
- RSS, RSSv2, and TSS
- VMware NetQueue, Microsoft Hyper-V VMQ (up to 208 dynamic queues)/Virtual Machine Multi-Queue (VMMQ)/Virtual Switch RSS (vRSS), Linux Multiqueue, and Virtual Machine Device queues (VMDq)
- DPDK
- Enhanced Network Stack for ESXi

Ethernet (continued)

Compliance

- IEEE Specifications
  - *802.1AS (Precise Synchronization)*
  - *802.1ax-2008 (Link Aggregation)*
  - *802.1p (Priority Encoding)*
  - *802.1q (VLAN)*
  - *802.1Qau (CN)*
  - *802.1Qaz (DCBX and ETS)*
  - *802.1Qbb (PFC)*
  - *802.3-2018 Annex 31B (Ethernet Pause Flow Control)*
  - *(RJ45) 802.3-2018 Clause 78 EEE (Energy Efficient Ethernet)*
  - *(25GbE) 802.3-201 8 Clause 110 (Direct Attach Copper), Clause 112 (SR optical), and Clause 114 (LR optical) (25G Ethernet)*
  - *(10GbE SFP+) 802.3-2018 Clause 52 (10Gb Ethernet Optical)*
  - *(RJ45) 802.3-2018 Clauses 55 and 40 (10GBASE-T and 1000BASE-T)*
  - *1588-2002 PTPv1 (Precision Time Protocol)*
  - *1588-2008 PTPv2*
  - *(10GbE SFP+) SFF8431 Annex E (10Gb Direct Attach Copper)*
- RFCs
  - *IPv4 (RFC 791)*
  - *IPv6 (RFC 2460)*

Board Firmware Features

- Secure Firmware Update process
- Smart Auto Negotiation (FastLinQ SmartAN)

RDMA

Universal RDMA

- RoCE
- RoCEv2
- iWARP
- Storage over RDMA: iSER, SMB Direct, S2D, and NVMe-oF
- NFSoRDMA

RDMA Use Cases

- S2D
- PVRDMA
- VF RDMA
- Live Migration
- SMB Direct
- NVMe-oF
- NFS
- RDMA
- CEPHS over RDMA

FCoE-Offload

Performance

- 3.6 million FCoE IOPS

iSCSI-Offload

Performance

- 2.9 million iSCSI IOPS

Forward Error Correction (FEC)

- FireCode or BASE-R IEEE 802.3-2015 Clause 74 or FC-FEC
- Reed Solomon IEEE 802.3by Clause 91 or RS-FEC

Tools and Utilities

Management Tools and Device Utilities

- QCS Command Line Interface (CLI) for Linux and Windows
- Plug-in for vSphere (GUI), and ESXCLI plug-in for VMware
- QCC PowerKit (Windows PowerShell®) cmdlets and RESTful APIs for Linux, VMware, and Windows
- Pre-boot UEFI HII system BIOS device configuration pages
- Native OS management tools for networking

Boot Support

- PXE 2.0
- UEFI
- iSCSI remote boot
- FCoE boot from SAN

Operating System Support

- For the latest applicable operating system information, see www.support.dell.com

Packaging

Ports

- Dual and quad port variants available. See the list of adapters and their features on page 8.

Note:
All advertised features are enabled in the hardware. Actual feature availability is dependent on software driver releases. See the release notes.

Packaging (continued)

Form Factor

- Low profile (MD2) PCI Express card with either one low profile bracket or one full height bracket (see Table 3).
- Custom Mezzanine form factor for the Dell PowerEdge® MX blade system
- Rack Network Daughter Card (rNDC) for Dell PowerEdge rack and tower systems
- Full Height PCI Express card (comes only with one full height bracket) 167.65mm × 111.28mm (6.60in. × 4.38in.)

Environment and Equipment Specifications

Temperature

- Operating: 32°F to 131°F (0°C to 55°C)
- Storage: –40°F to 149°F (–40°C to 65°C)

Airflow

- See the table on page 8.

Humidity (Relative, Non-condensing)

- Operating and non-operating: 10% to 90%

Compliance

- RoHS compliant

Cable Distance (Maximum)

Table 1. Cable Distance

Rate	Cable and Maximum Distance (m)			
	DAC	SR FOC	AOC	RJ-45
10G	7	400 OM4 300 OM3	20	37 to 55 CAT6 100 CAT6a/75
25G	5	100 OM4 70 OM3	20	—

DAC = Direct attach cable
SR FOC = SR fiber optic cable
AOC = Active optic cable
RJ-45 = 10BASE-T variants only

Approvals—Safety

US and Canada

- UL 60950-1
- CSA C22.2

Europe

- TUV EN60950-1
- TUV IEC 60950-1
- CB Certified

Agency Approvals—EMI and EMC

US and Canada

- FCC Rules, CFR Title 47, Part 15, Subpart Class A
- Industry Canada, ICES-003: Class A

Europe

- EN55032
- EN55024
- EN61000-3-2
- EN61000-3-3

Japan

- VCCI: Class A

New Zealand and Australia

- AS/NZS: Class A

Korea

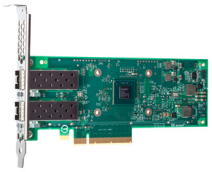
- KC-RRA Class A

Taiwan

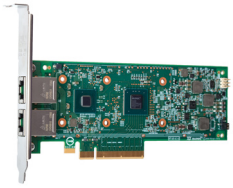
- BSMI CNS 13438

Table 2. Features

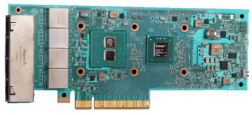
Adapter Name	QL41112 HFCU/HLCU	QL41162 HFRJ/HLRJ	QL41164 HFRJ/HLRJ	QL41262 HFCU/HLCU	QL41164 HFCU	QL41164 HMRJ	QL41162 HFRJ	QL41262 HMCU	QL41164 HMCU	QL41264 HMCU	QL41262 HMKR
General Specs											
Ports	2	2	4	2	4	4	2+2	2	4	2+2	2
Port Speeds	10	1/10	1/10	10/25	10	1/10	1 + 1/10	10/25	10	1 + 10	10/25
Connectors	SFP+	BASE-T	BASE-T	SFP+, SFP28	SFP+	BASE-T	BASE-T	SFP+, SFP28	SFP+	SFP+, 1GBASE-T	—
Form Factor	Low Profile PCIe	Low Profile PCIe	Low Profile PCIe	Low Profile PCIe	Full Height PCIe	rNDC	rNDC	rNDC	rNDC	rNDC	Blade Mezz
Media	DAC, optics, AOC	RJ-45	RJ-45	DAC, optics, AOC	DAC, optics, AOC	DAC, optics, AOC	RJ-45	DAC, optics, AOC	DAC, optics, AOC	DAC, optics, AOC, RJ-45	—
802.3az (EEE)	√	√	√	√	√	√	√	√	√	√	√
Advanced Configuration and Power Interface (ACPI), v2.0	√	√	√	√	√	√	√	√	√	√	√
SmartAN™ Mode	—	—	—	√	—	—	—	√	—	—	√
Storage											
Universal RDMA (RoCE/RoCEv2/ iWARP)	√	√	√	√	√	√	√	√	√	√	√
FCoE Offload	√	√	√	√	√	√	√	√	√	√	√
iSCSI Offload	√	√	√	√	√	√	√	√	√	√	√
Virtualization and Cloud											
Concurrent SR-IOV/ NPAR	√	√	√	√	√	√	√	√	√	√	√
DPDK	√	√	√	√	√	√	√	√	√	√	√
Flow Filtering	√	√	√	√	√	√	√	√	√	√	√
Tunneling Offload (VXLAN/ GENEVE/ NVGRE/GRE)	√	√	√	√	√	√	√	√	√	√	√
Physical Specifications											
Operating Temperature	0°C–55°C 32°F–131°F	0°C–55°C 32°F–131°F	0°C–55°C 32°F–131°F	0°C–55°C 32°F–131°F	0°C–55°C 32°F–131°F	0°C–55°C 32°F–131°F	0°C–55°C 32°F–131°F	0°C–55°C 32°F–131°F	0°C–55°C 32°F–131°F	0°C–55°C 32°F–131°F	0°C–55°C 32°F–131°F
Cooling Require-ments (LFM/°C)	250LFM at 55°C	250LFM at 55°C	250LFM at 55°C	250LFM at 55°C	250LFM at 55°C	250LFM at 55°C	250LFM at 55°C	250LFM at 55°C	250LFM at 55°C	250LFM at 55°C	250LFM at 55°C



QL41262HFCU
QL41112HFCU

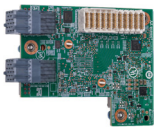


QL41162HFRJ

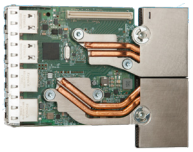


QL41164HxRJ

QL41164HFCU

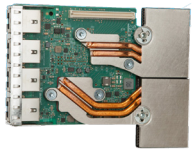


QL41262HMKR

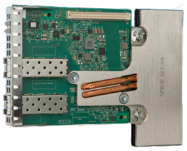


QL41162HMRJ

QL41264HMCU



QL41164HMRJ



QL41262HMCU
QL41162HMCU

Table 3. Ordering Information

Part Number	Factory Install SKU	Customer Install SKU	Description	Form Factor
QL41112HFCU-DE-BK	540-BBYK	540-BBYH	Dual Port 10GbE SFP+ Adapter (Full Height Bracket)	Low Profile PCIe
QL41112HLCU-DE-BK	540-BBZI	540-BBZM	Dual Port 10GbE SFP+ Adapter (Low Profile Bracket)	Low Profile PCIe
QL41162HFRJ-DE-BK	540-BBYJ	540-BBYG	Dual Port 10GbE BASE-T Adapter (Full Height Bracket)	Low Profile PCIe
QL41162HLRJ-DE-BK	540-BBZK	540-BBZN	Dual Port 10GbE BASE-T Adapter (Low Profile Bracket)	Low Profile PCIe
QL41164HFRJ-DE-BK	540-BCHG	540-BCHH	Quad Port 10GbE BASE-T Adapter (Full Height Bracket)	Low Profile PCIe
QL41164HLRJ-DE-BK	540-BCHC	540-BCHF	Quad Port 10GbE BASE-T Adapter (Low Profile Bracket)	Low Profile PCIe
QL41262HFCU-DE-BK	540-BBYL	540-BBYI	Dual Port 25GbE SFP28 Adapter (Full Height Bracket)	Low Profile PCIe
QL41262HLCU-DE-BK	540-BBZJ	540-BBZO	Dual Port 25GbE SFP28 Adapter (Low Profile Bracket)	Low Profile PCIe
QL41164HFCU-DE-BK	540-BCHE	540-BCHD	Quad Port 10GbE SFP+ Adapter (Full Height Bracket)	Full Height PCIe
QL41164HMRJ-DE-BK	555-BDYB	555-BDYG	Quad Port 10GbE BASE-T Adapter	rNDC
QL41162HMRJ-DE-BK	555-BDYF	555-BDXX	Dual Port 10GbE BASE-T/Dual Port 1GbE Adapter	rNDC
QL41262HMCU-DE-BK	555-BDYC	555-BDYD	Dual Port 25GbE SFP28 Adapter	rNDC
QL41164HMCU-DE-BK	555-BDXY	555-BDYE	Quad Port 10GbE SFP+ Adapter	rNDC
QL41264HMCU-DE-BK	555-BDYH	555-BDXZ	Dual Port 10GbE SFP+/Dual Port 1GbE Adapter	rNDC
QL41262HMKR-DE-BK	543-BBDI	540-BCJF	Dual Port 25GbE Blade Mezz Adapter	MX Mezz

All adapters support adaptive voltage scaling (AVS).
Twisted pair cabling, DAC cables, SR/LR optics are not included. See https://www.marvell.com/content/dam/marvell/en/public-collateral/ethernet-adaptersandcontrollers/marvell-ethernet-adapters-fastlinq-41000-interoperability-matrix-2019-06.pdf for a list of cables and optics that have been tested by Marvell and its partners.
10BGASE-T variants ship with RJ45 connectors. Intended for use with twisted pair copper cabling (not included)


MARVELL

Marvell first revolutionized the digital storage industry by moving information at speeds never thought possible. Today, that same breakthrough innovation remains at the heart of the company's storage, networking and connectivity solutions. With leading intellectual property and deep system-level knowledge, Marvell semiconductor solutions continue to transform the enterprise, cloud, automotive, industrial, and consumer markets. For more information, visit www.marvell.com.