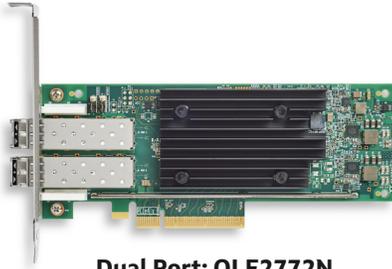


Marvell® QLogic® 2770 Series

Enhanced 32GFC Fibre Channel Adapters, PCIe® 4.0



Dual Port: QLE2772N

- The latest and most advanced 32GFC HBA from Marvell, available in single-port and dual-port versions
- Up to 2 million IOPS and 12,800MBps of aggregate throughput
- Port isolation design delivers deterministic and scalable performance on both ports
- NVMe over Fibre Channel capability allows simultaneous access to NVMe and SCSI based Storage on the same port
- Universal SAN Congestion Mitigation (USCM) helps pinpoint and prevent congestion by utilizing Fabric Performance Indication Notification (FPIN) technology
- Marvell StorFusion™ technology accelerates deployment, simplifies diagnostics, enhances reliability, and optimizes performance
- Supports PCIe 4.0 systems with backward compatibility with PCIe 3.0 systems

The Marvell QLogic 2770 Series Enhanced 32-Gigabit Fibre Channel (GFC) HBAs secure mission critical data with hardware-based Root of Trust (RoT).

Leveraging over 20 years of market leadership, the 2770 Series FC HBAs are designed from the ground up for customers looking to accelerate databases, host more virtual machines (VMs), and reduce total cost of ownership (TCO), while leveraging their investment in nonvolatile memory express (NVMe)-based all flash arrays. Marvell QLogic 2770 Series FC (32GFC) HBAs provide full backward compatibility with 16GFC and 8GFC SANs.

NVMe Over Fibre Channel (FC-NVME)

Workloads that demand higher throughput, IOPS, and lower latency are moving to flash. The NVMe protocol has been designed from the ground up for flash and features deep parallelism, random access, and flash access over PCI Express® (PCIe) to maximize bandwidth.

NVMe works best when coupled with a network that can provide lossless, low-latency, and high-performing transport. FC-NVMe extends these benefits over a Fibre Channel fabric.

The 2770 Series Adapters support low-latency access to scale out NVMe with full support for the FC-NVMe protocol. The 2770 Series Adapters can simultaneously support FC-NVMe and FCP-SCSI storage traffic on the same physical port, enabling customers to migrate to NVMe at their own pace.

The 2770 Series FC adapters bring the best of both worlds by offering up to 2 million IOPS and line rate 32GFC performance, while delivering low-latency access to NVMe and SCSI storage over a Fibre Channel network.

Firmware Integrity Protection with Hardware Root of Trust

Security threats continue to evolve and increase, driving Chief Information Officers towards securing the server all the way down to the firmware at the lowest layers of the server platform, where attacks are the most difficult to detect. To address this issue, the Marvell QLogic 2770 Series Adapters incorporate a hardware RoT that prevents malicious firmware from injecting malignant code into the FC HBA. The 2770 Series RoT enables both integrity and authenticity during adapter firmware updates by both validating firmware embedded signatures with hardware embedded keys to ensure that only bona-fide firmware executes, and protecting firmware updates that are applied over public networks.

Fully Featured FC Technology

Marvell QLogic FC technology provides the industry's most fully featured 32GFC adapter, designed to meet and exceed the requirements of modern SANs. Marvell's FC solution offers 50-percent higher per-port performance (1 million IOPS) than previous generations; and its power-efficient, port-isolated design enables data centers to reduce their carbon footprint.

Marvell QLogic 2770 Series FC HBAs resolve data center complexities by enabling a storage network infrastructure that supports powerful virtualization features like N_Port ID virtualization (NPIV), application-aware services with standards based quality of service (QoS), and simplified management.

Marvell StorFusion technology delivers streamlined provisioning and improved resiliency with built-in forward error correction (FEC). These features address the needs of agile IT organizations that run hybrid cloud infrastructures and require mission-critical reliability, guaranteed network performance, and the ability to scale their SANs to business needs.

The Enhanced 32GFC, 2770 Series Adapters also incorporate a secure hardware-based RoT to protect against rogue firmware.

Innovations that Improve Business Productivity and Integrity

Marvell QLogic FC Adapters powered by StorFusion technology include advanced capabilities when deployed with supported Brocade® and Cisco® switches. By implementing these industry-leading solutions together, SAN administrators can take advantage of enhanced features that improve availability, accelerate deployment, and increase network performance.

Marvell Universal SAN Congestion Mitigation Technology (USCM)

SAN congestion, although rare, has the potential to quickly spread and significantly disrupt application performance leading to lost business. Modern SANs, specifically those with flash storage and mix of Fibre Channel endpoint speeds can be prone to congestion. SAN Congestion typically occurs when slower FC endpoints cannot accept responses generated by flash/NVMe storage, a condition referred to as oversubscription/over-utilization. Rarely, a misbehaving FC device can also lead to SAN congestion when it is unable to replenish credits which are key to reliable Fibre Channel transmissions, a condition referred to as slow-drain. SAN congestion when timely detected, can be isolated and decisive actions applied. A Fibre Channel standard, Fabric Performance Impact Notifications (FPINs) bring congestion awareness to FC endpoints.

Utilizing FPINs, the 2770 Series Adapters implement Universal SAN Congestion Mitigation Technology (USCM). USCM uniquely works both Brocade and Cisco SAN fabrics to keep applications running at peak performance by providing an in-band and zero touch SAN congestion detection, notification, and avoidance system. Marvell QLogic 2770 Series Adapters interact with Cisco and Brocade SANs using both the more reliable FC primitive signaling as well as protocol events to bring awareness of the presence of congestion, peer congestion, link integrity, lost frames, etc. These adapters also have the ability to enable decisive actions such as fine-grained I/O throttling,

automatic path failover, load balancing, and flow quarantining to ensure that SAN congestion is mitigated with minimum impact to application performance.

Marvell QLogic USCM technology, offered at no additional cost, brings strong awareness of SAN congestion and implements decisive actions to prevent application degradation. It is highly recommended for modern SANs.

Improved Total Cost of Ownership and Reliability

StorFusion technology delivers advanced link diagnostics, which improve availability and support for high-performance fabrics. Using the Diagnostics Port feature with a Brocade or Cisco switch that supports Fibre Channel diagnostics, administrators can quickly run a battery of automated diagnostic tests to assess the health of links and fabric components.

The Marvell QLogic 2770 Series Adapters support link cable beacon (LCB) technology, which enables administrators to visually identify both ends of a physical link.

Read diagnostic parameters (RDP) provide optics and media diagnostics while the link is in service, enabling identification of link-related errors and degrading conditions on the HBA-to-FC switch link.

Automatic buffer-to-buffer credit recovery (BB-CR) helps overcome performance degradation, congestion, and link resets caused by buffer credit loss, especially on longer distance and high-loss fiber connections.

Rapid Server Deployment and Orchestration

StorFusion technology includes fabric pre-provisioning services that enable servers to be quickly deployed, replaced, and moved across the SAN. By leveraging fabric-assigned port worldwide name (FA-WWN) and fabric-based boot LUN discovery (F-BLD) capabilities, the creation of zones, LUNs, SAN-based boot images, and other services can be completed before the servers arrive on site—eliminating time-consuming, manual tasks that typically delay server deployment.

Higher Resiliency and Performance with Automatic Error Recovery

Forward error correction (FEC) improves performance and link integrity to support higher end-to-end data rates by automatically recovering from many transmission errors without re-sending the frames. FEC automatically detects and recovers from bit errors, which results in higher availability and performance.

Automatic buffer-to-buffer credit recovery (BB-CR) helps overcome performance degradation, congestion, and link resets caused by buffer credit loss, especially on longer distance and high-loss fiber connections.

Performance SLA Enforcement with VM-level QoS

Network performance can be dramatically improved by implementing the industry-standard class-specific control (CS_CTL)-based frame prioritization QoS, which helps alleviate network congestion. When Dell adapters with Marvell StorFusion technology are connected to supported SAN fabrics, traffic is classified as it arrives at the switch,

and is then processed on the basis of configured priorities. Traffic can be prioritized for delivery or subjected to limited delivery options. As a result, mission-critical workloads can be assigned a higher priority than less time-sensitive network traffic for optimized performance.

Simplified Management

The Marvell unified management application, QConvergeConsole® (QCC), provides single-pane-of-glass management across generations of Marvell QLogic FC adapters. In addition, Marvell supports all major APIs for deployment flexibility and integration with third-party management tools, including the VMware vCenter™ and Brocade Network Advisor.

Unparalleled Insight and QoS for Virtualized Deployments

The Marvell 2770 Series Adapters support several standards-based virtualization features that optimize virtual server deployment, troubleshooting, and application performance.

Marvell QLogic virtual machine ID (VM-ID) technology seamlessly integrates with Brocade and Cisco switches to allow customers to effectively monitor and manage their Fibre Channel storage networks, load balancing VM clusters with storage to ensure efficient use of the storage resources. Supported for VMware ESXi 6.x, 7.x, and later, I/O requests and responses can be tagged with the VM-ID of the appropriate virtual machine, providing end-to-end visibility at the VM level.

Additionally, support for NPIV enables a single FC adapter port to provide multiple virtual ports for increased network scalability. Standard class-specific control (CS_CTL)-based QoS technology per NPIV port allows multi-level bandwidth controls and guarantees per VM. As a result, mission-critical workloads can be assigned a higher priority than less time-sensitive storage traffic for optimized performance.

High Availability and Reliability

Marvell QLogic Enhanced 32GFC Adapters continue the tradition of complete port-level isolation across the FC controller architecture. This architecture, unlike other vendor solutions, provides independent function, transmit and receive buffers, an on-chip CPU, DMA channels, and a firmware image for each port. These features enable complete port-level isolation, prevent errors and firmware crashes from propagating across all ports, and provide predictable and scalable performance across all ports. The Marvell architecture delivers ultimate reliability to meet the needs of mission-critical enterprise applications with lower power and fewer CPU cycles, all while maintaining peak performance. See Figure 1 and Figure 2.

The 2770 Series Adapters also provide end-to-end data integrity with support for T10 Protection Information (T10 PI), which prevents the risk of silent data corruption in environments running Oracle® Linux® with the Unbreakable Enterprise Kernel.

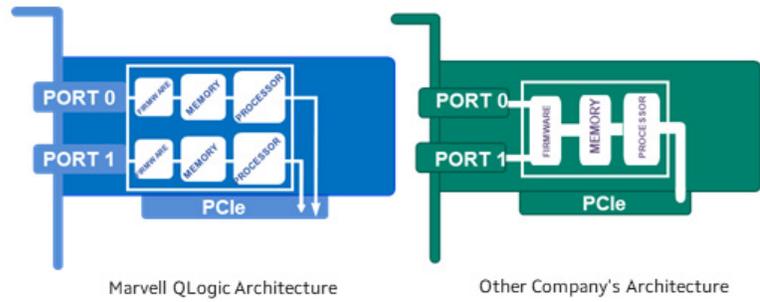


Figure 1. Port Isolation

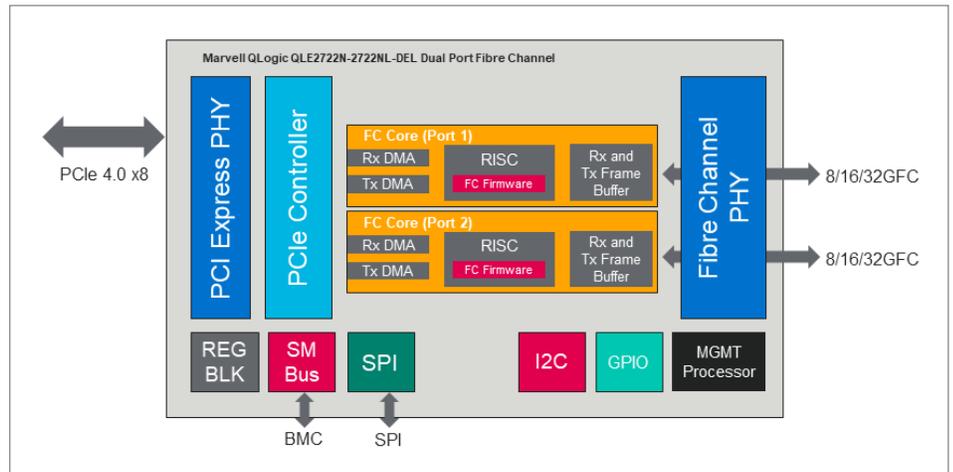


Figure 2. Marvell QLogic QLE2770N/2770NL-DEL Series Block Diagram

Leadership, Confidence, and Trust

The Marvell 2770 Series Adapters are compatible with the same FC software driver stack that has been tested and validated across all major hardware platforms, all major hypervisors, and operating systems. Operating at 32GFC, these adapters are backward compatible with existing 16/8GFC infrastructure, leveraging existing SAN investments.

Marvell QLogic is the undisputed leader in FC adapters, with over 20 years of market share leadership with over 22 million ports shipped, and multiple generations of FC products that have been qualified by all major server OEMs. Marvell owns the most established, proven FC stack in the industry with more FC ports shipped than any other vendor.

Host Bus Interface Specifications

Bus Interface

- QLE2770N-DEL: PCIe 4.0 x8 (single-port)
- QLE2770NL-DEL: PCIe 4.0 x8 (single-port)
- QLE2772N-DEL: PCIe 4.0 x8 (dual-port)
- QLE2772NL-DEL: PCIe 4.0 x8 (dual-port)

Host Interrupts

- INTx and MSI-X

Compliance

- *PCIe Base Specification*, rev. 4.0
- *PCIe Card Electromechanical Specification*, rev. 3.0
- *PCIe Card Electromechanical Specification*, rev. 4.0 draft 0.9
- *PCI Bus Power Management Interface Specification*, rev. 1.2
- *PCI Hot Plug Specification*, rev. 1.1

Fibre Channel Specifications

Negotiation

- 32/16/8GFC auto-negotiation

Throughput

- 6,400MBps full duplex line rate per port (maximum)

Logins

- Support for 2,048 concurrent logins and 2,048 active exchanges per port

Port Virtualization

- NPIV

Compliance

- *SCSI Fibre Channel Protocol-4 (FCP-4)*
- *Fibre Channel Tape (FC-TAPE) Profile*
- *Fibre Channel Generation Services-8 (FC-GS-8)*
- *Fibre Channel-Physical Interface-5 (FC-PI5)*
- *Fibre Channel-Physical Interface-6 (FC-PI6)*
- *Fibre Channel Link Services 4 (FC-LS-4)*
- *Fibre Channel Framing and Signaling-4 (FC-FS-4)*
- *Fibre Channel-NVMe (FC-NVMe)*

Tools and Utilities

Management Tools and Device Utilities

- QConvergeConsole CLI: a unified management tool that supports multiple generations of Marvell FC adapters
- MCTP/PLDM
- ESXCLI Plug-in for vSphere
- MRVLC PowerKit (cmdlets for Windows PowerShell)
- QCC Plug-ins for vSphere
- Marvell QLogic FC QCC Extension for Windows Admin Center

Boot Support

- BIOS
- Unified Extensible Firmware Interface (UEFI)
- Forth code (FCODE)

APIs

- SNIA HBA API V2
- SMI-S

Operating Systems

- For the latest applicable operating system information, see Marvell.com

End-to-End Provisioning and Management Features

The following features require a supported Brocade or Cisco switch.

Performance

- QoS CS_CTL
- FEC for 16GFC
- BB-CR: automatic buffer credit loss detection and recovery
- FPIN and hardware signaling for Congestion Management

Diagnostics

- Diagnostics Port
- LCB
- RDP

Deployment and Management

- FA-WWN
- F-BLD
- FC ping
- FC traceroute
- VM-ID
- Fabric device management interface (FDMI) enhancements

Physical Specifications

Ports

- QLE2772N-DEL: dual-port FC
- QLE2772NL-DEL: dual-port FC

Form Factor

- Dual port: low profile PCIe card (6.6 inches x 2.731 inches)

Environment and Equipment Specifications

Temperature

- Operating: 0°C to 55°C (32°F to 131°F)
- Storage: -20°C to 70°C (-4°F to 158°F)

Humidity

- Relative (noncondensing): 10% to 90%
- Storage: 5% to 95%

Cable Distances

- Multimode optic:

| Rate | Cable and Distane (m) | |
|-------|-----------------------|---------|
| | OM3 | OM4/OM5 |
| 8GFC | 150 | 190 |
| 16GFC | 100 | 125 |
| 32GFC | 70 | 100 |

Agency Approvals—Safety

US and Canada

- UL 60950-1
- CSA C22.2

Europe

- TUV EN60950-1
- TUV IEC 60950-1
- EN/IEC 62368 2nd, 3rd Edition
- CB Certified

Agency Approvals—EMI and EMC (Class A)

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

**Agency Approvals—EMI and EMC
(Class A) (continued)**

Japan

- VCCI: Class A

New Zealand and Australia

- AS/NZS: Class A

Korea

- KC-RRA Class A

UK

- UKCA

Taiwan

- BSMI CNS 13438

Ordering Information

QLE2770N-DEL-BK

- With server, order SKU# 540-BDKL
- Without server, order SKU# 540-BDKO
- Ships with 32GFC SR optical transceivers installed
- Ships with full-height bracket installed

QLE2770NL-DEL-BK

- With server, order SKU# 540-BDKN
- Without server, order SKU# 540-BDKM
- Ships with 32GFC SR optical transceivers installed
- Ships with half-height bracket installed

QLE2772N-DEL-BK

- With server, order SKU# 540-BDHC
- Without server, order SKU# 540-BDHO
- Ships with 32GFC SR optical transceivers installed
- Ships with a full-height bracket installed

QLE2772NL-DEL-BK

- With server, order SKU# 540-BDGU
- Without server, order SKU# 540-BDHM
- Ships with 32GFC SR optical transceivers installed
- Ships with a low-profile bracket installed.



To deliver the data infrastructure technology that connects the world, we're building solutions on the most powerful foundation: our partnerships with our customers. Trusted by the world's leading technology companies for 25 years, we move, store, process and secure the world's data with semiconductor solutions designed for our customers' current needs and future ambitions. Through a process of deep collaboration and transparency, we're ultimately changing the way tomorrow's enterprise, cloud, automotive, and carrier architectures transform—for the better.

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