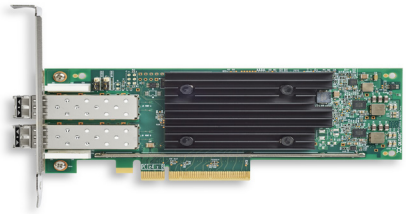
Marvell® QLogic® QLE2872C/2772C-DEL Adapters

High Performance, Secure, 64GFC and 32GFC PCIe® 4.0 Fibre Channel Adapters



Dual Port: QLE2872C

- Up to 50% higher IOPS and twice the throughput of total full duplex over previous generations
- Up to 2x faster data mining improves database transactional performance and enables faster business decisions
- Advanced security features for Zero Trust Architecture, including CNSA secure boot and signed drivers
- Silicon Root of Trust with CNSA ensures SAN Security with Cryptographically Signed Firmware
- Improve scale out NVMe efficiencies by delivering concurrent support for FCP and FC-NVMe on the same port
- Automated SAN Congestion Mitigation (USCM) helps pinpoint and prevent SAN Congestion utilizing Fabric Performance Indication Notification (FPIN) technology
- Port isolation design delivers deterministic and scalable performance on all ports while improving reliability

The Marvell QLogic QLE2872C and QLE2772C Adapters are high performance and low latency PCIe 4.0, 64-Gigabit Fibre Channel (GFC) and 32-Gigabit Fibre Channel (GFC) Host Bus Adapters (HBAs) that secure mission critical data with silicon Root of Trust. These adapters are available in dual ports across the PCIe 4.0 standard form factor with industry leading performance, high bandwidth, and low latency.

Leveraging over 20 years of Fibre Channel (FC) expertise, the Marvell QLogic QLE2872C/2772C Adapters 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 QLE2872C adapters provide full backward compatibility with previous generations of 32GFC and 16GFC SANs, and the Marvell QLogic QLE2772C are backwards compatible with 16GFC and 8GFC SANs.

Firmware Integrity With PQC Silicon Root of Trust

Public key algorithms are an essential technology to ensure effective and secure authentication. Due to advancements in computing, there is concern that public key systems could someday be compromised by quantum computers. This has resulted in a critical requirement to protect systems from future deployment of cryptographically relevant quantum computers (CRQC).

Marvell, the pioneers in security and data encryption was the first to address the silicon Root of Trust issue with the Marvell QLogic 2870 Series Adapters which prevent malicious firmware from hijacking the FC HBA.

Security threats continue to evolve, driving CIOs to secure data center infrastructure from application software all the way down to firmware and hardware components of the server platform, where malicious attacks are the most difficult to detect. To address this issue, the Marvell QLogic QLE2872C/2772C Adapters offer advanced security features including post quantum cryptography (PQC) incorporated into silicon Root of Trust, secure boot, and digitally signed drivers. The Marvell QLogic QLE2872C/2772C Adapters Root of Trust provides both integrity and authenticity checks during adapter firmware updates by validating firmware embedded signatures with hardware embedded keys to ensure that only trusted firmware executes, and protecting firmware updates that are applied over public networks.

The Commercial National Security Algorithm Suite (CNSA) is a set of cryptographic algorithms standardized by the National Security Agency. CNSA serves as the cryptographic base to protect US National Security Systems information up to the top secret level, while the NSA plans for a transition to quantum-resistant cryptography.

- Marvell StorFusion™ technology accelerates deployment, simplifies diagnostics, enhances reliability, and optimizes performance
- Supports PCIe 4.0 systems

The Marvell QLogic QLE2872C/2772C Adapters feature CNSA compliant protection against CRQC to fortify immutable silicon Root of Trust operations:

- Verify firmware signatures prior to firmware load and execution
- Securely recover firmware to known good state and authentic state on detection of compromised firmware
- Anti-Rollback of unauthorized firmware

NVMe® Over Fibre Channel (FC-NVMe)

Workloads that demand higher throughput, IOPs, and lower latency are moving to flash storage media. 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 Marvell QLogic QLE2872C/2772C Adapters support low-latency access to scale out NVMe with full support for the FC-NVMe protocol. The Marvell QLogic QLE2872C/2772C 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 Marvell QLogic QLE2872C/2772C Adapters bring the best of both worlds by offering up to 2 million IOPs and line rate 64GFC performance, while delivering low-latency access to NVMe and SCSI storage over a Fibre Channel network.

Fully Featured FC Technology

Marvell QLogic FC technology provides the industry's most fully featured 64GFC adapter product line, designed to meet and exceed the requirements of modern SANs. Marvell's FC solution offers industry leading performance, while its power-efficient, port-isolated design enables data centers to reduce their carbon footprint.

Marvell QLogic QLE2872C/2772C Adapters 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.

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.

High Performance Automated SAN Congestion Mitigation Technology

Modern SANs, specifically those with flash storage and a 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. 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 Marvell QLogic QLE2872C/2772C Adapters implement Universal SAN Congestion Mitigation Technology (USCM). USCM uniquely works both independently and in coordination with 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 QLE2872C/2772C 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 QLE2872C/2772C 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.

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 QLogic QLE2872C/2772C Adapters support several standards-based virtualization features that optimize virtual server deployment, troubleshooting, and application performance.

Marvell QLogic virtual machine ID (VMID) 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 VMID 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 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 Marvell QLogic QLE2872C/2772C 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.

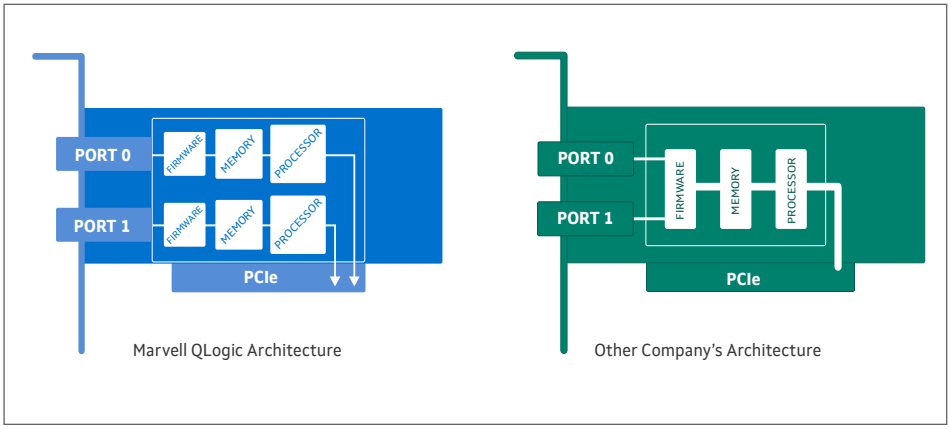


Figure 1. Port Isolation

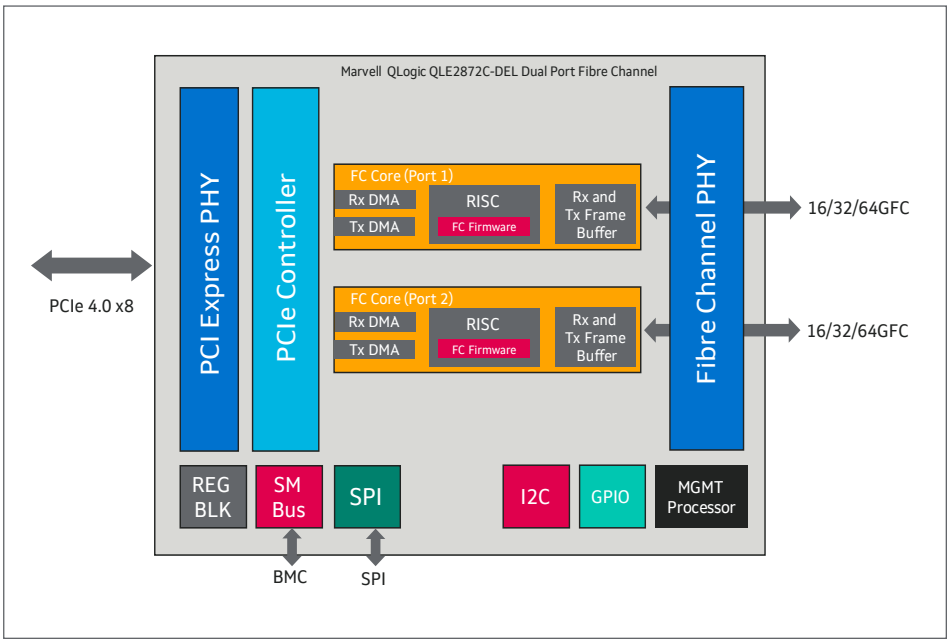


Figure 2. Marvell QLogic QLE2872C-DEL Series Block Diagram

Leadership, Confidence, and Trust

The Marvell QLogic QLE2872C/2772C 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 64GFC and 32GFC respectively, these adapters are backward compatible with existing 32/16GFC and 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

- QLE2872C-DEL: PCIe 4.0 ×8 (dual-port)
- QLE2872CL-DEL: PCIe 4.0 ×8 (dual-port)
- QLE2772C-DEL: PCIe 4.0 ×8 (dual-port)
- QLE2772CL-DEL: PCIe 4.0 ×8 (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

- QLE2872C/CL: 64/32/16GFC auto-negotiation
- QLE2772C/CL: 32/16/8GFC auto-negotiation

Throughput

- QLE2872C/CL: 12,800MBps full duplex line rate per port (maximum)
- QLE2772C/CL: 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)*

Zero Trust Architecture Security Features

- Post Quantum Silicon Root of Trust (ECDSA 384P)
- Secure boot and signed drivers
- CNSA Compliant

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
- MRVLFC PowerKit (cmdlets for Windows
- PowerShell)
- QCC Plug-ins for vSphere
- Marvell QLogic FC QCC Extension for Windows Admin Center

Root of Trust / Boot Support

- Digitally signed firmware compliant with CNSA 1.0
- Unified Extensible Firmware Interface (UEFI)

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

End-to-End Provisioning and Management Features

Deployment and Management

- FA-WWN
- F-BLD
- FC ping
- FC traceroute
- VMID
- Fabric device management interface (FDMI)

Physical Specifications

Brackets

- QLE2872C and QLE2772C: Full-Height Bracket
- QLE2872CL and QLE2772CL: Low-Profile Bracket

Form Factor

- Dual port: low profile PCIe card 6.6 inches × 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 Distance (m)	
	OM3	OM4/OM5
8GFC	150	190
16GFC	100	125
32GFC	70	100
64GFC	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

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

QLE2872C-DEL-BK

- Ships with 64GFC SR optical transceivers installed
- Ships with full-height bracket installed

QLE2872CL-DEL-BK

- Ships with 64GFC SR optical transceivers installed
- Ships with low-profile bracket installed

QLE2772C-DEL-BK

- Ships with 32GFC SR optical transceivers installed
- Ships with a full-height bracket installed

QLE2772CL-DEL-BK

- Ships with 32GFC SR optical transceivers installed
- Ships with a low-profile bracket installed

MARVELL

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 over 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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