MARVELL

White Paper

Real-World Requirements from Fibre Channel HBAs

Get the facts about how Fibre Channel HBA capabilities improve real-world application performance

December 2020

Key Takeaways

- **Applications:** Databases, data mining and business critical applications are amongst the most common enterprise workloads that rely on Fibre Channel (FC) storage area networks (SANs)
- **Expectations:** FC SAN applications require highly available, reliable and consistent high performance from the server and storage infrastructure
- **Performance:** Most modern enterprise applications that require block access to storage operate at I/O block sizes of 4-8KB and higher and are more read I/O centric
- **Latency:** All flash arrays have significantly reduced end to end latency for applications, but overall latency is still in the order of milliseconds of which the FC HBA contributes to a very small and insignificant portion
- **Consistency:** Marvell® QLogic® FC HBAs deliver transactional and throughput performance at par with industry peers, but take the lead in delivering more reliable connectivity as well as consistent performance powered by technologies like StorFusion™

Executive Summary

Enterprise organizations rely on their Fibre Channel SAN for fast, reliable access to critical applications and data. To keep up with growing business demands and exponential data growth, IT administrators deploy the latest servers, solid-state storage SSD and NVMe devices, and storage network components to meet performance and service level agreement (SLA) objectives. QLogic Enhanced 32GFC adapters from Marvell deliver real-world value by delivering a robust solution powered by its unique port isolation technology, maximum IOPS at 4KB-8KB block sizes that enterprise applications require and silicon root of trust that ensures FC SAN integrity.

This paper details Marvell's assessment of what IT administrators and managers should expect in terms of capabilities and performance from their FC SAN infrastructure and without being misled by claims from other vendors that tout capabilities which have little relevance to the real world. Marvell QLogic Enhanced 32GFC technology resolves data center complexities by enabling a storage network infrastructure that allows peak performance of mission-critical business applications while delivering application aware services, and simplified management.

Key Drivers for Successful FC SAN Connectivity

1. **Performance:** Typical real-world deployments of enterprise and private cloud applications operate at block sizes ranging from 4KB to 256KB. Enterprise database online transaction processing (OLTP) operates at 4-8KB; data warehousing at 64KB; and data recovery and backup applications use 128-256KB block size of I/O to transact with block storage. What can be misleading is many storage and HBA vendors make performance claims based on 512-byte block-size transactions, and this can set expectations that will never be achieved in the real world. IT administrators and storage architects should assess their SAN components based on performance in real-world block sizes of 4-8KB and above.

2. **Reliability:** SAN applications rely on the proven reliability of Fibre Channel components to provide a robust and reliable infrastructure that delivers to the business-critical needs of the enterprise applications. For these reasons it is typical to see that most SANs architectures are designed for high availability using techniques like multi-pathing, redundant components for failover, automatic error recovery and thorough test and qualification processes followed by vendors. It is recommended that IT administrators and storage architects talk to SAN equipment vendors and ask them if seemingly redundant paths of a SAN components like FC HBAs with multiple ports are indeed backed by redundant and isolated components.

3. **Security:** Fibre Channel SANs are typically deployed as a segregated network but could still be prone to attacks and potential injection of rogue firmware. Server administrators should consult their FC HBA vendor to see if their firmware images are signed and validated with root of trust and if encryption services are available in the FC HBA..

4. **Manageability:** Fibre Channel SANs can span across several racks and involve hundreds to thousands of endpoints. It is essential for enterprise data centers to have in place capabilities specific to SAN components such as FC HBAs that enable end to end orchestration and simplified diagnostics of the mission-critical data storage framework..

Data Sheet vs Real World Performance

There is often confusion on how FC HBAs like the QLogic 2690 Series of Enhanced 16GFC and 2770 Series of Enhanced 32GFC contribute to the success and performance of the overall solution. Below are some guidelines that enable solution architects SAN and server administrators to make the right choice and implement the most relevant solution to host their databases, virtualization systems and other business apps.

Enterprise Applications and their IO Patterns: Figure 1 articulates the mapping between various I/O block sizes used by different types of enterprise applications. As is evident from the charts, most enterprise applications operate in block sizes above 4KB. Hence 512Bytes performance metrics sometimes stated by FC HBA vendors have little relevance or value to real-world applications. IT administrators and storage architects should evaluate SAN performance metrics based on more realistic real-world block sizes.

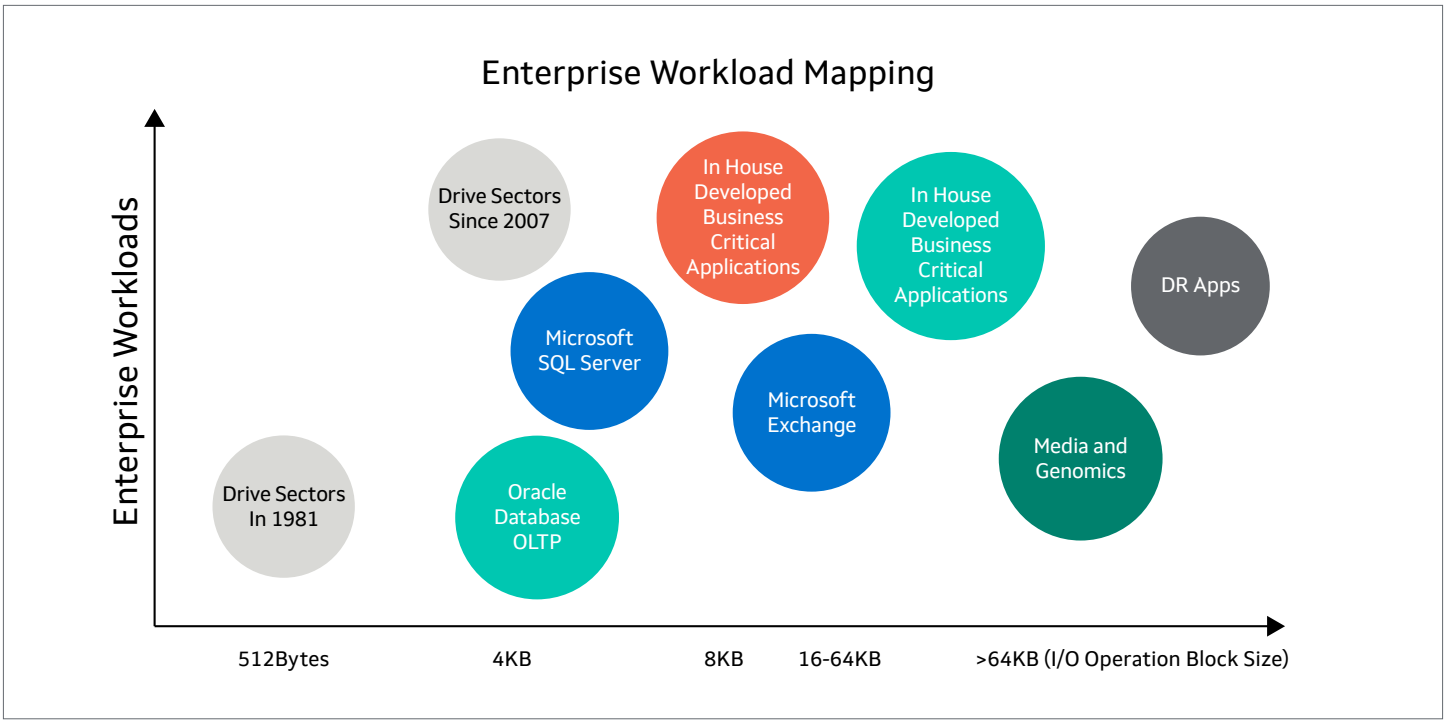
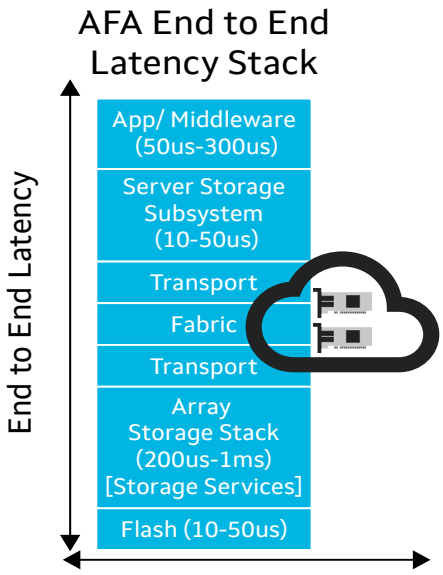


Figure 1: Map of how enterprise applications utilize I/O block sizes.



a. **Latency:** Latency for storage operations is defined as the amount of time an I/O request (a read or a write) takes to complete. Latency in a SAN should be evaluated based on a full round trip from the server through the stack and HBA through the network to the storage array and back. Latency is an important measure of the responsiveness of the SAN and is even more important in the rapidly emerging world of NVMe media and FC-NVMe connections. However, application experts and server administrators should be cognizant that there are many factors that contribute to this end to end latency. See Figure 2: it is important to note that FC HBA latency measure is in single-digit microseconds, while Storage Array latency measure is in milliseconds making HBA latency irrelevant for real-world applications

Figure 2: End to End latency profiling of FC SANs. FC HBAs and Switches form an insignificant portion.

e. **Transactions per second or IOPS:** I/O Operations per second (IOPS) is a function of block size and bandwidth. Sometimes, storage and FC HBA vendors tout their maximum IOPS capabilities in "millions of IOPS" – they are typically stated at 512Byte block size and as it is evident from Figure 1, there are few if any enterprise apps that run at 512 byte operations. Figure 3 (based on Marvell internal test results) articulates the maximum HBA IOPS for the block sizes that are typical to enterprise applications, and even for those block sizes, the FC HBA IOPS capabilities far exceed the application requirements. Note that for each of the block sizes listed in Figure 3, the FC HBAs achieve the maximum performance that the 32GFC line rate permits, making the millions of IOPS claims by other vendors irrelevant.

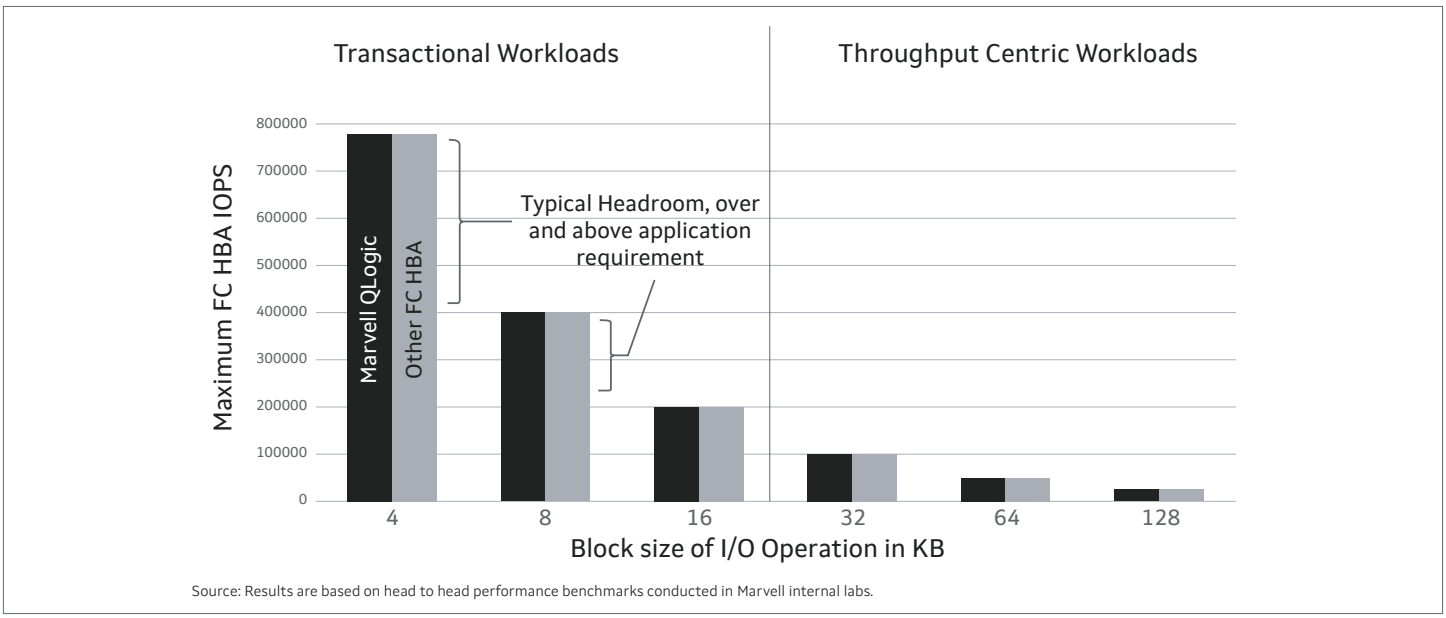


Figure 3: Head to Head Performance for Enterprise Workloads. Single Port 32GFC in Microsoft Windows Server 2019.

I/O Histograms from the Storage Array Perspective

A successful FC SAN architecture and design encompasses a well-matched combination of server with FC HBA, a switch and a storage array. In the conversation around I/O block sizes and its mapping to enterprise applications, one of the best perspectives one can obtain is from the storage array itself. Figure 4 depicts this data as analyzed and reported by PureStorage and HPE Nimble. In summary, both these charts clearly indicate that enterprise applications operate in block sizes of 4KB and higher. It is also important to note that while all flash arrays can deliver about 1-2 million IOPS, they are typically shared amongst several applications/servers (see Figure 5) thereby limiting the amount of IOPS performance each server can achieve.

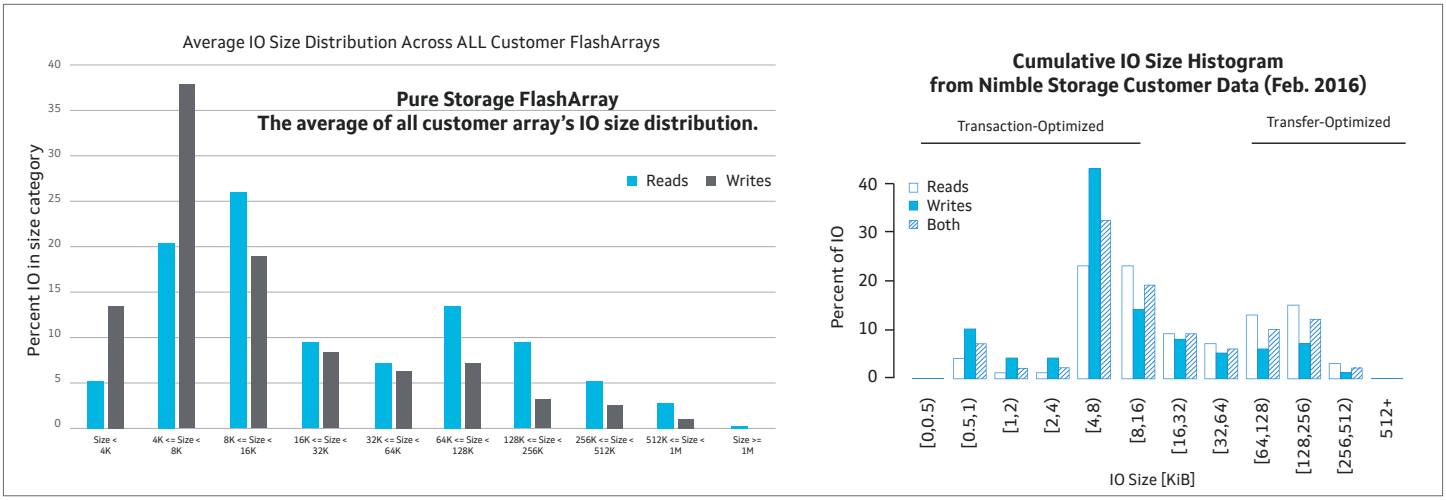


Figure 4: I/O Histograms of real-world use cases from Storage Array Vendors using analytics

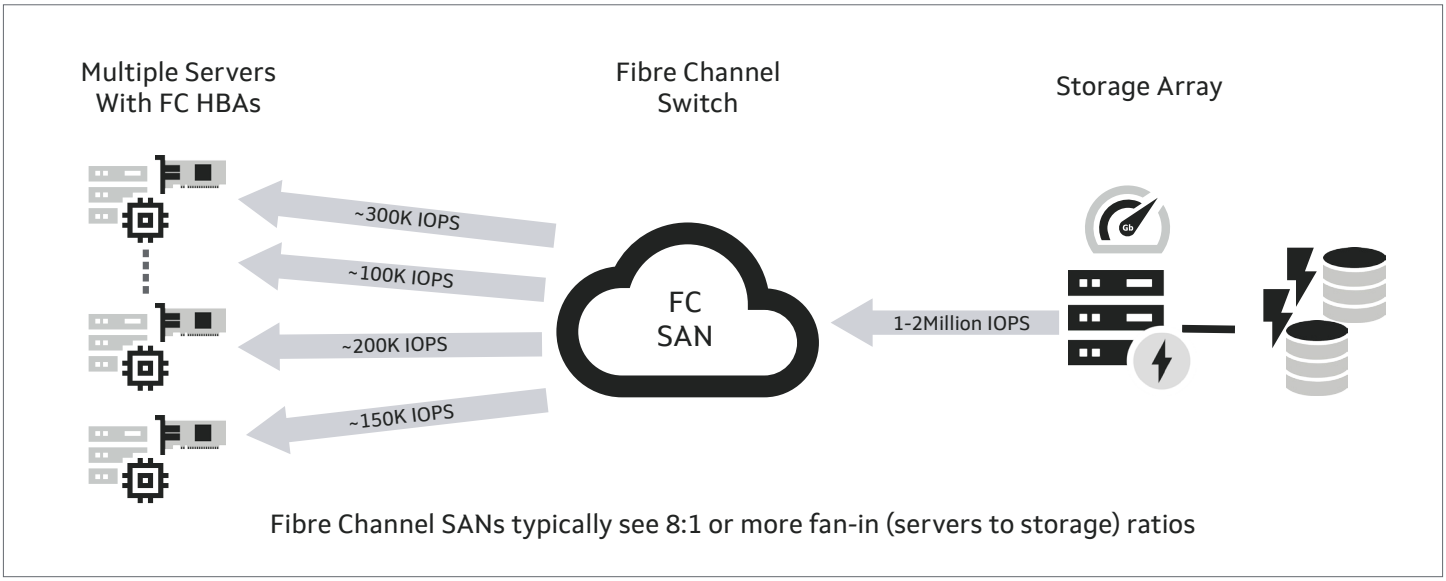


Figure 5: Typical FC SAN deployment and how Storage Array capabilities are shared by multiple applications

Why Marvell QLogic

Performance:

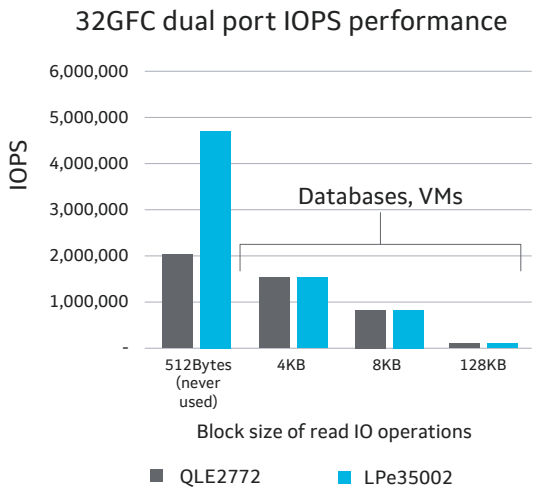
Marvell QLogic 2690/2700 Series of Enhanced 16GFC and 32GFC technology resolves data center complexities by enabling a storage network infrastructure that supports peak performance of mission-critical business applications, enables efficient use of server resources, and delivers a highly efficient block storage transport mechanism. The 2700 Series delivers 1.5 Million Read IOPS for 4KB block sizes and close to 800K IOPS for 8KB block size (based on Marvell internal test results), which delivers enough headroom for enterprise application.

Reliability, Security and Manageability:

Marvell QLogic Enhanced 16GFC and 32GFC adapters feature a high-availability architecture aligned with true enterprise-class, mission-critical requirements. The Marvell QLogic architecture offers complete port-level isolation across its quad-port ASIC. The 2700 Series architecture provides discreet functionality with separate processor, memory, and firmware for each port.

Marvell QLogic Enhanced 16GFC and Enhanced 32GFC adapters include advanced capabilities (like StorFusion) enabled when deployed with supported Brocade and Cisco switches and systems. By implementing these industry-leading solutions together, administrators can take advantage of enhanced features that improve reliability, accelerate deployment, and ensure highly deterministic application performance.

Head-to-head perf for real world apps



Marvell leads in what matters to end-customers!

Feature	MRVL QLogic	BRCM Emulex	Customer Value
Max IOPS	2.2 Million	5 Million	@512b Not real world
Trunking	X	✓	Proprietary
PCIe Gen4	✓	✓	Not for 2x32GFC
Root of Trust	✓	✓	Secure FW Updates
Encryption	✓	X	Protecting a valuable asset - Data
Port Isolation	✓	X	Reliability, predictability
Unified Driver for FC and FC-NVMe	✓	X	Simplicity, Risk
Universal SAN Congestion	✓	X	Marvell supports both BRCD and Cisco

Source: Results are based on head to head performance benchmarks conducted in Marvell internal labs.

Figure 6: Summary of Marvell QLogic 2700 Series vs. Broadcom LPe35000 Series. Perf metrics for Microsoft Windows Server 2019.

Key Takeaways

Marvell QLogic 2690/2700 Series of Enhanced 16GFC and Enhanced 32GFC technology resolves data center complexities by enabling a storage network infrastructure that ensures highly deterministic peak performance of mission-critical business applications, enables efficient use of server resources, and delivers a highly efficient block storage transport mechanism. Server and SAN administrators should evaluate FC HBAs for performance for I/O profiles that actually matter and not get distracted with micro benchmarks that are not indicative of the real world. Marvell QLogic Fibre Channel remains the clear choice of customers wanting the most advanced and reliable Fibre Channel solution to drive enterprise applications.

Learn More

www.marvell.com/QLogic

https://www.marvell.com/products/fibre-channel-adapters-and-controllers.html