

Emulex[®]-branded Fibre Channel HBA Product Line

Data Sheet

Emulex-branded Fibre Channel (FC) Host Bus Adapters (HBAs) by Broadcom are designed to address the demanding performance, reliability and management requirements of today's enterprises that are deploying low latency all-flash and hybrid networked storage arrays.

Emulex HBAs are available in Gen 6 (32/16GFC) and Gen 5 (16/8GFC) and are designed for the challenging application workloads running on all-flash and hybrid arrays. Also available are 8GFC HBAs, designed for more traditional hard disk drive arrays and tape libraries. All HBAs are available in single, dual and quad-port configurations. The product line offers a variety of performance and feature options such as diagnostics, Quality of

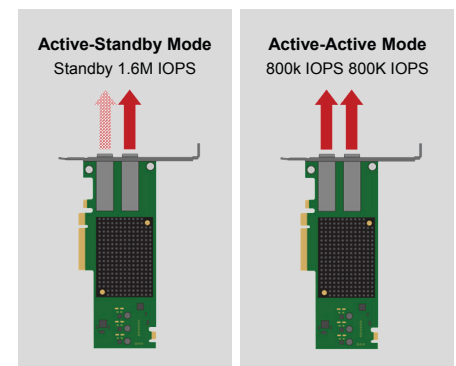
Service (QoS) and troubleshooting features to meet the needs of a wide range of enterprise applications.

With a common driver model supporting all Emulex HBAs for each operating system, upgrading to next generation Emulex HBAs guarantees seamless migration.

Additionally, Fibre Channel technology is backward compatible with the two previous generations. For example, Gen 6 (32GFC) Fibre Channel switches, HBAs and optics (transceivers) are backward compatible with 16GFC and 8GFC equipment. This provides a smooth upgrade path and investment protection for enterprises.

Accelerate

The unique Emulex Dynamic Multi-core Architecture on Gen 5 and Gen 6 FC HBAs delivers unparalleled performance and more efficient port utilization than other HBAs. With the ability to dynamically apply ALL ASIC resources on-the-fly to any port, Emulex delivers performance where it's needed.



Choosing the Emulex HBA That's Right for Your Needs

Models	Ability to maximize investment in flash storage	Microsoft SQLServer & Oracle Database data warehousing performance (compared to 8GFC)	Throughput (MB per second)	Maximum IOPS per single-port	Performance matching to hypervisor versions	Advanced features/ support for Brocade diagnostic features
Gen 6 32GFC	Ultimate	4x faster	3200	1.6M	VMware ESXi 6.0+	Complete support
Gen 6 16GFC	High	2x faster	1600	1.6M	VMware ESXi 6.0+	Complete support
Gen 5 16GFC	Fair	2x faster	1600	1.2M	VMware vSphere 5	Partial support
Gen 4 8GFC	Low	N/A	800	200k	VMware vSphere 4	N/A

For a complete list of models and supported features, refer to pages 4 & 5.

Emulex Gen 6 FC HBAs are able to provide full IOPS performance—1.6 million IOPS, to a single-port, which is critical when using dual-port HBAs in an active-standby configuration. In fact, over 80% of HBAs sold are dual-port or quad-port and configured for active-standby fail-over mode.

In high-density virtual environments with mixed storage, scaling to meet business needs can be complex and often results in performance reduction. Emulex ExpressLane provides QoS and application performance bypassing any potential congestion.

Emulex ExpressLane assigns traffic priorities on the host application's storage path. This priority allows Fibre Channel frames to get to targets quickly, much like a highway express lane. The Emulex Gen 5 and Gen 6 FC HBA provides a fully compatible prioritized frame to a Brocade switch, ensuring needed throughput for critical I/O during peak times in a scaled-out environment. ExpressLane is easily enabled from Emulex OneCommand® Manager extending into Brocade's fabric QoS.

NVM Express (NVMe) is a relatively new protocol for solid-state storage devices built with non-volatile memory technologies. NVMe provides substantially lower latency for storage I/O operations and significantly higher IOPS per device. NVMe will scale-up the number of devices it can address by adopting "NVMe over Fabrics" technology. Fibre Channel is one of the fabric technologies that will be supported by NVMe over Fabrics, and the Emulex Gen 6 Fibre Channel adapters are NVMe over Fabrics Ready.

Protect

Emulex HBAs are renowned for reliability, ensuring maximum SAN uptime. Their "It Just Works" reputation is based on 17 million installed ports with proven industry-leading reliability of 10 million hours field Mean Time Between Failures (MTBF).

T10 Protection Information (T10 PI) data integrity provides data protection from the server to the storage array. As one of the founders of the Data Integrity Initiative, Emulex, along with Oracle and Seagate, was instrumental in defining the T10 PI standard, which, along with the Data Integrity Extensions standard, delivers full end-to-end data integrity.

The new Secure Firmware update feature supported by Emulex Gen 6 FC HBAs protects the integrity of firmware with compliance to NIST—SP800-147B standards. Secure Firmware is a feature whereby the Fibre Channel adapter firmware is digitally signed by Emulex. The signature is verified at the time of a firmware update, only allowing authentic firmware images to be loaded on the adapter. This eliminates the possibility of loading firmware that has been tampered with, making security attacks more difficult for hackers.

Forward Error Correction (FEC) is a Gen 6 Fibre Channel standard feature for HBAs and switches that provides enhanced data reliability and performance by automatically detecting and recovering from

bit errors. It is especially useful in diverse and complex user environments such as blade system implementations. FEC is a digital signal processing technique that introduces redundant data, called an error correcting code, prior to data transmission or storage. FEC then provides the receiver with the ability to correct errors without a reverse channel to request the retransmission of data, thereby improving performance.

Control

The flagship OneCommand Manager enterprise-class management application features a multiprotocol, cross-platform architecture that provides centralized management of all current and previous generations of Emulex FC HBAs. This enables IT administrators to manage network connectivity with one tool for maximum efficiency.

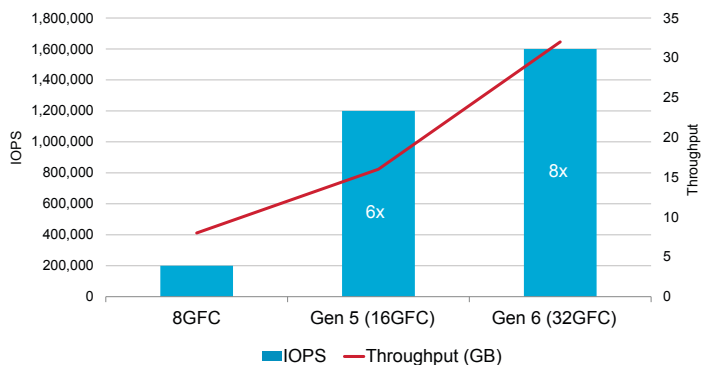
Troubleshooting Emulex HBAs is simplified with OneCapture, an Emulex device driver utility that gathers system, adapter, device driver, and applications information. Data collected by OneCapture is compressed into a single file and can be sent to Broadcom Technical Support for analysis when debugging system issues or for diagnostic purposes.

Additionally, select Emulex-branded Gen 6 and Gen 5 FC HBAs support Brocade features including Brocade I/O Insight, ClearLink (D_Port), Link Cable Beacons, Host Name Registration and Read Diagnostic Parameters.



Performance Comparisons of Emulex Fibre Channel HBA Generations

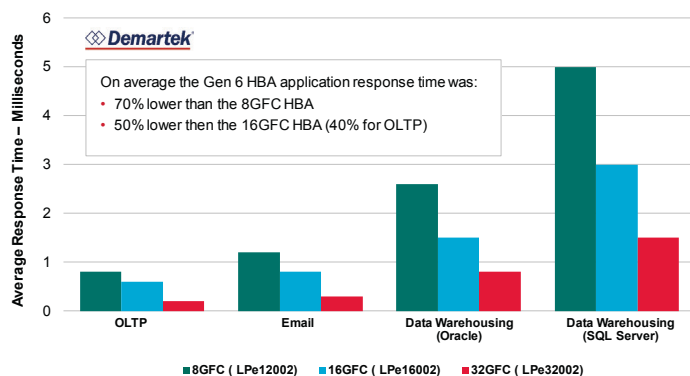
IOPS/Throughput Comparison



- Emulex Gen 6 FC HBAs deliver an industry-leading 1.6 million IOPs on a single-port
 - up to 8X more IOPS than 8GFC HBAs
 - up to 6X more IOPS than Gen 5 (16GFC) HBAs
- Gen 6 HBAs provide 2x the bandwidth of the previous generation HBAs

Average Response Time by Application

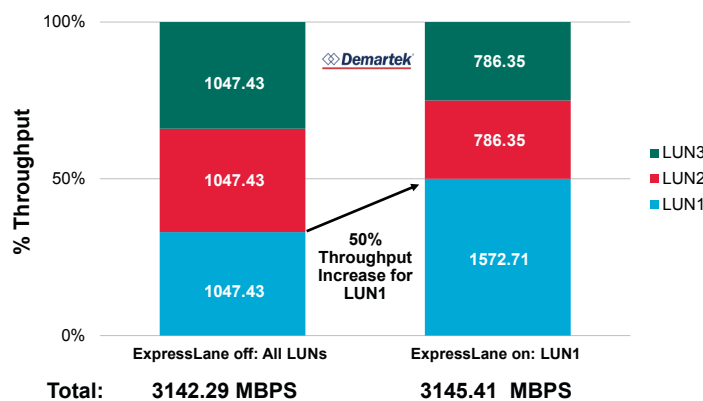
(Lower is Better)



- Application response time, or latency, is heavily dependent on the application workload.
 - online transaction processing (OLTP) workloads have very low latencies because they request small amounts of data
 - data warehousing workloads have much higher latencies because of the large volume of data that is usually requested

Emulex ExpressLane Throughput Advantages

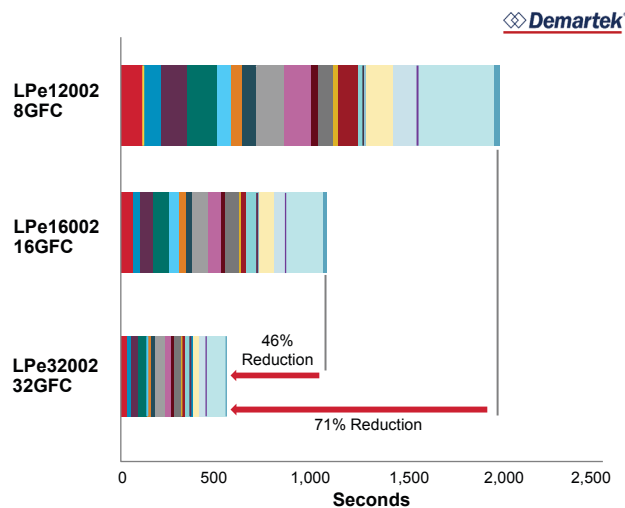
Single Port — LPe32002 (3200 MB/s theoretical max)



- ExpressLane allows one LUN to be given higher priority than the other LUNs on the same connection, providing I/O to mission-critical apps during peak times in a scaled-out environment
- With ExpressLane enabled on one LUN in the tests above, the LUN achieved a 50% higher throughput versus the other two LUNs without ExpressLane enabled (without modifying the workload or its settings)

Workload Acceleration-Oracle & SQLServer Decision Support Query Completion Times

(Lower is Better)



- The Demartek testing above consisted of a fixed set of 22 queries of a database that examines large volumes of data
 - Installing faster 32GFC HBAs reduced the time queries completed by 71% compared to 8GFC HBAs and reduced it by almost half compared to 16GFC HBAs

Maximum performance and superior management efficiency for the broadest range of data center environments

Feature	Description	PCI 3.0 HBAs					PCI 2.0 HBAs
		LPe32000 LPe32002	LPe31000 LPe31002 LPe31004	LPe16000B LPe16002B	LPe16004	LPe15004	LPe1200x
Link speed support	4GFC		•	•	•	•	•
	8GFC	•	•	•	•	•	•
	16GFC	•	•	•	•		
	32GFC	•	Upgradeable to 32GFC (except 4-port)				
Ports	Number of Fibre Channel connections on one HBA	1, 2	1, 2, 4	1, 2	4	4	1, 2, 4
Throughput	Large block transfer speed	3200 MB/s	1600 MB/s	1600 MB/s	1600 MB/s	800 MB/s	800 MB/s
IOPS	Input/output operations per second per port	1.6M (total)	1.6M (total)	1.2M (total)	2.4M (total)	1.2M (total)	200k
PCIe bus		3.0	3.0	3.0	3.0	3.0	2.0
HBA port virtualization	N_Port ID Virtualization (NPIV)	•	•	•	•	•	•
T10 PI (firmware-based)	T10 PI end-to-end data integrity						•
T10 PI with offload	T10 PI end-to-end data integrity support with hardware offload	•	•	•	•	•	
ClearLink diagnostics port (D_Port)	Optical and signal integrity for optics and cables	•	•	•	•		
ExpressLane™	Quality of Service feature prioritizes Logical Unit Numbers, such as flash devices, for significant latency gains	•	•	•	•		
Forward Error Correction	Enhanced data reliability and performance by automatically detecting and recovering from bit errors.	•	•				
Secure Firmware Updates	Protects the integrity of firmware with compliance to NIST–SP800-147B standards	•	•				
Brocade I/O Insight, Link Cable Beaconsing, Host Name Registration, Read Diagnostic Parameters	Advanced I/O monitoring and diagnostics.	•	•				
Spare optics kits available	For use as on-site spare optics	•	• (except 4-port)	•	•		•
VM workload	Exchanges and logins	16,127	16,127	8192	8192	8192	4096
	Virtual functions	255	255	255	255	255	None
Message Signaled Interrupts support	MSI	•	•	•	•	•	•
	MSI-X	•	•	•	•	•	•
	Number of MSI-X vectors supported	1024	1024	1024	1024	1024	32

Maximum performance and superior management efficiency for the broadest range of data center environments

Feature	Description	PCI 3.0 HBAs					PCI 2.0 HBAs
		LPe32000 LPe32002	LPe31000 LPe31002 LPe31004	LPe16000B LPe16002B	LPe16004	LPe15004	LPe1200x
Operating system	Windows	•	•	•	•	•	•
	Linux	•	•	•	•	•	•
	VMware	•	•	•	•	•	•
	Solaris	•	•	•	•	•	•
FC-Tape		FCP-4	FCP-4	FCP-2	FCP-2	FCP-2	FCP-2
All topologies	Auto detect – P To P; FC-AL; fabric	• Not Applicable for FC-AL	• Not Applicable for FC-AL	•	•		•
Fibre Channel fabric boot	X86 BootBIOS	•	•	•	•	•	•
	UEFI	•	•	•	•	•	•
	OpenBoot	•	•	•	•	•	•
FC-SP compliance	Fibre Channel Security Protocol with DH-CHAP authentication (host to switch)			•	•		•
Common management interface (FDMI)	Industry-standard interface across all operating system environments	•	•	•	•		•
Firmware upgrade	Upgradeable features on installed base	•	•	•	•	•	•
Firmware independent drivers	Update F/W or drivers separately simplifies SAN management	•	•	•	•	•	•
End-to-end Parity/CRC	Data protection	•	•	•	•	•	•
Host PCI slot compatibility	Short length (standard height)	•	• 4-port is low profile only	•	•	Low-profile only	•
	Low profile compatible		•	•		•	•
Media interface	LC multi-mode/short wave	•	•	•	•	•	•
	Digital diagnostics	•	•	•	•	•	•

Options

Part number	Description
LPe12100-OPT	8GFC spare optic (short wave laser with LC connector SFP+ optic) - 1 pack
LPe16100-OPT	Gen 5 (16GFC) spare optic (short wave laser with LC connector SFP+ optic) - 1 pack
LPe16100-OPTx2	Gen 5 (16GFC) spare optic (short wave laser with LC connector SFP+ optic) - 2 pack
LP32-SW-OPT-1	Gen 6 (32GFC) spare optic (short wave laser with LC connector SFP+ optic) - 1 pack
LP32-SW-OPT-2	Gen 6 (32GFC) spare optic (short wave laser with LC connector SFP+ optic) - 2 pack



For product information and a complete list of distributors, please visit our website at: emulex.com

Copyright © 2016 Broadcom. All Rights Reserved. The term "Broadcom" refers to Broadcom Limited and/or its subsidiaries. Broadcom, the pulse logo, Connecting everything, the Connecting everything logo, Emulex, and OneCommand are the trademarks of Broadcom in the United States, certain other countries and/or the EU. For more information, please visit www.broadcom.com. BCO0-0424EN 09.07.16