

Get the most out of the all-flash data center with HPE Gen6 Fibre Channel



Introduction

Enterprises are increasingly recognizing the benefits of investing in all-flash storage not just for the most demanding, performance- and latency-sensitive applications, but for use with all types of production data and business-critical applications. In addition to the well-known performance benefits and operational savings offered by flash storage as compared to spinning-disk, the dramatic increase in I/O throughput and reduction in latency also improves host server CPU efficiency, which can produce dramatic cost savings for software licensing linked to server CPU and core counts. With such a strong correlation between storage performance increases and licensing cost savings, it makes sense that ensuring the realization of maximum performance gains in reality—not just in theory—should be a priority for any new flash storage deployment. Doing so would certainly seem prudent if the goal is to ensure full economic benefit and return on flash storage investment.

To maximize the performance value of their flash storage investment, users must look not just at the storage, but also at the choice of connectivity to the host servers. HPE StoreFabric Gen6 Fibre Channel features 32 gigabit-per-second (Gbps) connectivity that the SAN performance of HPE 3PAR StoreServ All-Flash Storage, even when connecting at speeds below the 32 Gbps maximum data rate. In addition to faster throughput speeds and increased inputs/outputs per second (IOPS), Gen6 Fibre Channel provides enhanced monitoring and diagnostics capabilities available in HPE StoreFabric Power Pack+ Software that provide visibility into network latency levels and IOPS to the Virtual Machine (VM) level. These functions ensure not only the fast and consistent performance that Fibre Channel provides, but also greater visibility into SAN network performance to prevent a wide range of issues from impacting operations.

Why HPE StoreFabric Gen6 Fibre Channel for Flash?

Key benchmark results for HPE StoreFabric Gen6

- Up to 4X more queries in the same time even with 8 Gb Fibre Channel storage
- Boosted application response times by 50% compared to 16 Gb networking components and 71% compared to 8 Gb components
- Support storage growth without bottlenecking application performance

Getting the maximum value out of the low-latency, high-throughput designs of all-flash and flash-enhanced hybrid storage designs requires both fast connectivity and consistency of performance through highly deterministic data delivery. Benchmark testing with simulated workloads show that faster SAN network speeds improve the overall ability of flash storage to maximize IOPS, even if the storage connectivity speed is less than the maximum network throughput. Integrating a flash array with 8 Gb Fibre Channel connectivity into a Gen6 storage fabric with 32 Gb connectivity to HPE ProLiant DL Gen9 family of servers, for example, enables the completion of up to four times more queries in the same time.

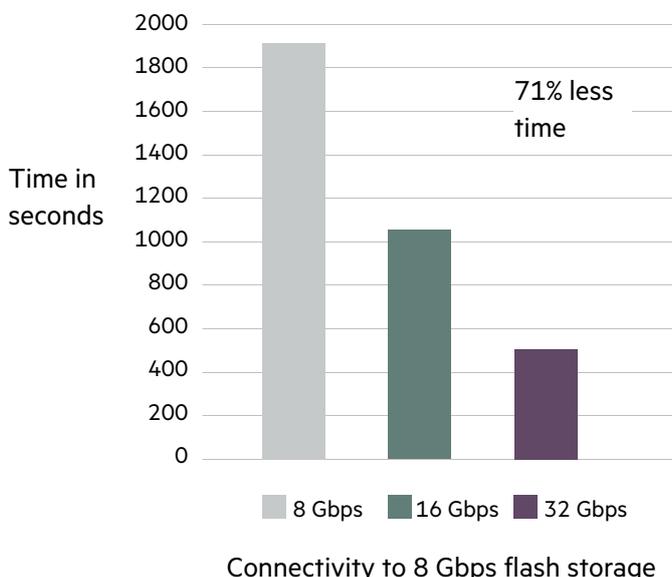


Figure 1. Emulex/Broadcom TPC-H benchmark testing: Accelerate 8 Gb flash storage with 32 Gb networking





Furthermore, Gen6 connectivity provides an average of 50 percent reduction in application response times compared to 16 Gb storage networks and Host Bus Adapters (HBAs) and a 71 percent reduction over 8 Gb networks and HBAs.¹ The incremental performance gain achieved by the flash storage provides a significant additional advantage that enhances the application response time, the efficiency of the IT infrastructure, and the overall return on storage investment (see Figure 1).

For workloads like Online Transaction Processing (OLTP), this increase in performance translates into an increase in transactions executed and a gain in revenue generation for the organization. From this perspective, a small incremental investment in an optimized server and network infrastructure enables maximum utilization of the array performance, delivering a real increase in ROI from capital expenditures. As the need to scale the storage environment grows, and more flash storage is added into the environment with faster connectivity speeds, Gen6 networks can support storage growth without bottlenecking the application performance.

In addition to offering fast throughput speeds, Fibre Channel fabrics ensure a highly reliable network with deterministic data delivery, a critical aspect for ensuring consistency of data transfer with predictable performance under normal use. As network speeds increase, the criticality of avoiding Fibre Channel frame retransmission retries due to bit errors becomes essential, in order to meet the Fibre Channel standard for bit error rates and maintain optimal performance levels.

Brocade pioneered the adoption of Forward Error Correction (FEC) in Gen5 Fibre Channel for enhanced link reliability. FEC is integral to the Gen6 standard of sustaining 32 Gb throughput with HPE PremierFlex Fibre Optic OM4 cable. This ability to correct bit errors without discarding the frame is vital at higher data transfer speeds, specially where older cabling or longer links are in use to sustain or achieve the reliability of transmission and almost eliminate the need for performance-disrupting IO retransmissions. This consistency of response time allows application administrators and storage vendors to optimize their tuning of response times for specific workloads more accurately. This results in faster performance levels and greater value from the flash-enhanced array.



Maximizing network efficiency with HPE StoreFabric Power Pack+ Software, which includes Brocade Fabric Vision Technology

Flash storage improves IO response times by up to 10X.¹ If the connectivity from the host to the storage is not functioning optimally, however, the impact is amplified when high congestion impacts data flows. The resulting performance issues are often extremely difficult to diagnose. One consequence of the widespread use of host-based virtualization is that the mixed workloads resulting from multiple applications whose own individual workload profiles are difficult to characterize can cause unanticipated congestion and impact performance. In such situations, it is unclear where to assign blame: to the application owner, or to the storage administrator? Also, it might take days or weeks to identify the root cause of the problem.

Flash storage is often used to mitigate the so-called IO blender effect, where storage performance can become degraded under heavy workloads in virtualized environments as I/O processes that might otherwise have been relatively sequential become randomized. But the use of flash can further ensure that no limitation prevents line-speed operations. Fabric Vision™ is a suite of tools and capabilities designed to pre-validate, monitor, and troubleshoot storage environments to prevent issues from occurring and to mitigate their impact when they do occur. HPE StoreFabric Gen6 Fibre Channel extends these capabilities with the introduction of the Brocade IO Insight capability, which is included in HPE StoreFabric Power Pack+ Software—the industry’s only integrated network sensor that provides deep visibility into the IO performance of storage infrastructure. This enhanced visibility enables quick identification of degraded application performance at host and storage tiers, reducing time-to-resolution.

IO Insight proactively monitors IO performance and behavior to provide unparalleled insight into problems and ensure service levels. With IO Insight, fabric administrators can baseline their performance profile for both IO and storage latency. The monitoring capability in the HPE Power Pack+ Software, SAN Monitoring and Alerts Policy Suite (MAPS) with activity dashboards then enables administrators to quickly identify threshold spikes in IOPS activity. For activity that does not comply with expected behavior, preventative actions can be defined—ranging from administrative notifications to port fencing—to prevent greater negative impact (see Figure 2).

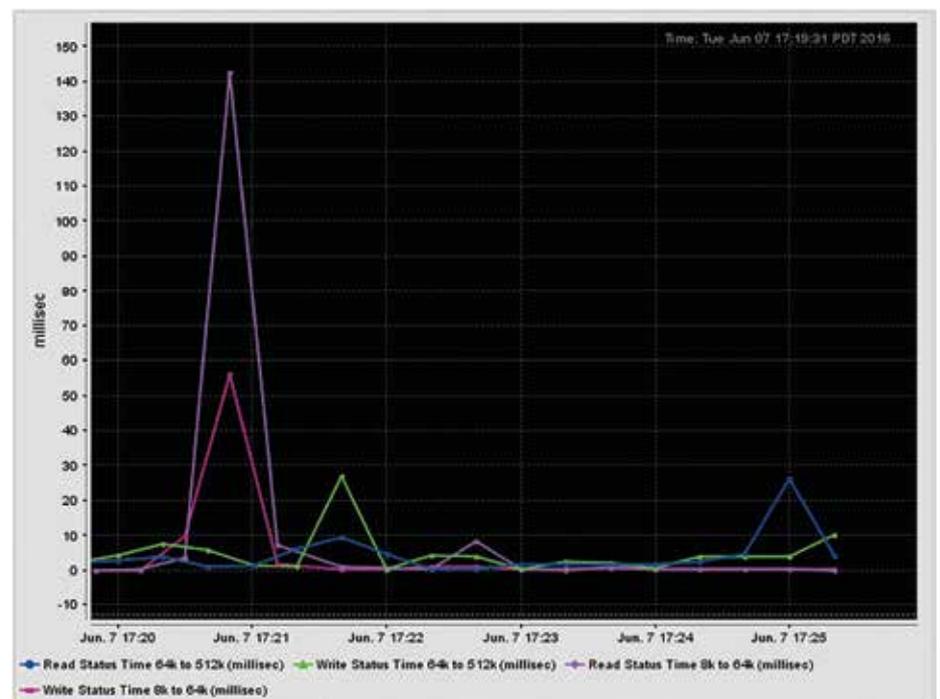
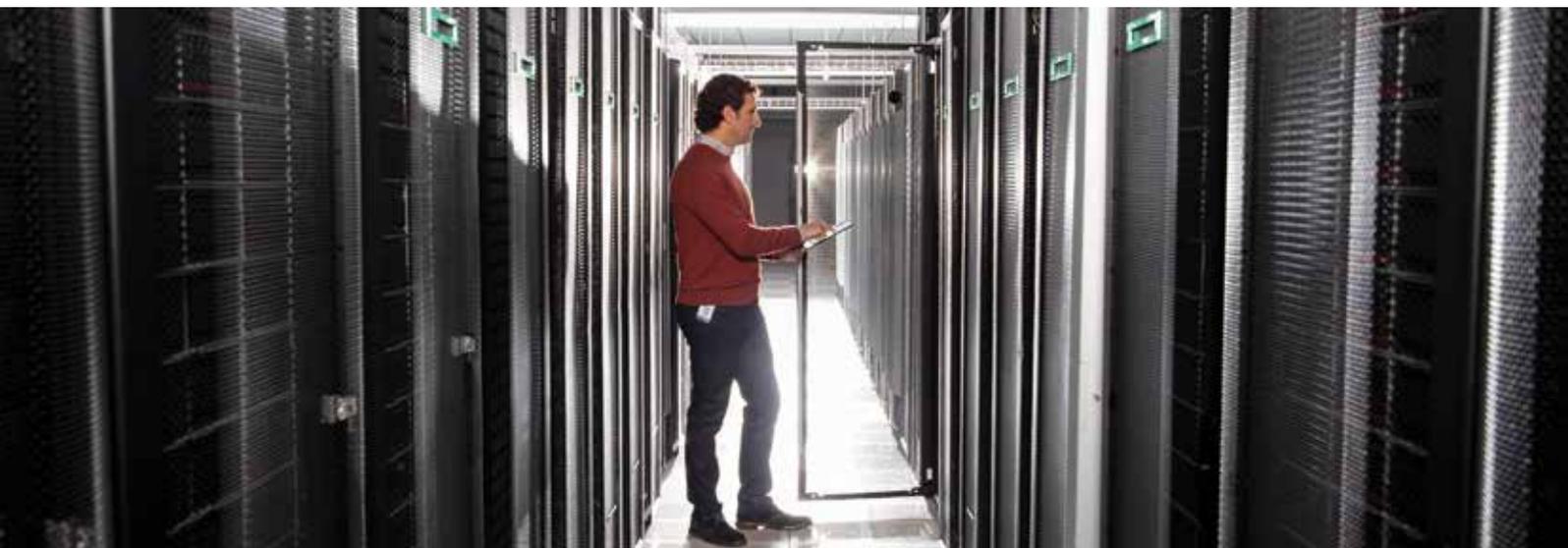


Figure 2. IO Insight metrics displayed in a Brocade Network Advisor real-time performance graph





IO monitoring allows greater insight into storage performance and provides demonstrable evidence of achieving critical Service Level Agreements (SLAs) as well. IO Insight enables proactive IO monitoring of the following areas:

- Total IOs at a flow level to monitor workload profiles over time
- First response times (maximum and average) for an IO request
- IO latency for Exchange Completion Time (ECT) maximum and average
- Outstanding IO in queue, maximum and average

Hewlett Packard Enterprise recommends the HPE Complete Brocade Analytics Monitoring Platform (AMP) for additional insight into end-to-end application performance across the entire fabric. The AMP can monitor up to 20,000 data flows and millions of IOPS,² with benchmark metrics that include latency, IOPS, and pending IO. Monitoring these metrics across the fabric can identify behavior anomalies and help ensure predictable performance, while avoiding downtime to the network and to applications. For more details, visit [HPE Complete](#).

Increasing performance with seamless integration of NVMe over Fabrics

Looking forward, the next wave of all-flash arrays will provide connectivity of flash media to Non-Volatile Memory Express (NVMe) over Fabrics, offering the opportunity for further reductions in latency and performance gains. Using flash media connected to NVMe over Fabrics enables direct communication from the host server to the storage subsystem using Peripheral Component Interconnect express (PCIe) commands, thus avoiding the Small Computer Systems Interface (SCSI) translation layer that impacts storage response latency. While this translation time is not significant in a traditional spinning disk-based storage device relative to the overall disk response time, the impact is relatively higher in a flash-based array where seek time and rotational delays are dramatically reduced, creating an opportunity to improve response times by as much as 10 times.³

² hpe.com/in/en/storage/hpe-complete.html

³ demartek.com/Demartek_HPE_StoreFabric_Gen6_32GFC_Server_Storage_Solution_Evaluation_2016-11.html



Automated SAN Orchestration for all-flash

As the need to deploy all-flash storage increases, storage administrators are increasingly dealing with more demanding schedules to configure storage and provision SAN deployments faster. HPE StoreFabric, and its OEM partners including Brocade, have collaborated to develop a software-defined network solution that is distributed across HPE 3PAR StoreServ All-Flash Storage, HPE StoreFabric B-series Fibre Channel switches, and HPE StoreFabric Fibre Channel HBAs (targets, host, and switches), to automate and simplify the tedious nature of SAN zoning (SAN orchestration) all from the HPE 3PAR All-Flash Storage System. The resulting solution, HPE Smart SAN for 3PAR, features the following capabilities:

- Automated SAN Orchestration—Fibre Channel Industry Association (FCIA) T-11 Standards-based Target-Driven Peer Zoning (TDPZ) and HPE 3PAR Federated Peer zoning for simplified host provisioning, in minutes not hours
- Investment Protection—Support for Gen6 32 Gb and Gen5 16 Gb FC fabrics and HPE 3PAR StoreServ Storage Systems
- Standards Based—FCIA Standard-based FC device registration via FDMI protocols and FC read diagnostic parameter (RDP) for SAN diagnostics

For more details, visit hpe.com/storage/smartsan

Carrying NVMe over Fabrics integrated with HPE StoreFabric Gen6 Fibre Channel delivers the performance advantage of NVMe-connected storage media while using existing Fibre Channel network infrastructure. Fibre Channel networks are already ready for use with NVMe over Fabrics, and they offer the same design characteristics of fast throughput, resilient operations, and high reliability that makes Fibre Channel the storage connectivity option of choice for enterprise data centers. This allows organizations to seamlessly integrate HPE StoreFabric Gen6 Fibre Channel networks with next-generation NVMe over Fabrics without a disruptive rip-and-replace operation. By integrating the efficiency of NVMe over Fabrics with the high performance and low latency of Gen6 Fibre Channel, organizations can scale IOPS to deliver the performance, application response time, and scalability needed for next-generation data centers.

Gen6 Fibre Channel builds on these qualities. As storage response latencies are reduced, server efficiencies and IOPS increase further, shifting more demand onto the network. The 32 Gb throughput allows support for more VMs and higher IOPS, while introducing minimal latency, ranging from sub-microsecond to low, single-digit microseconds of latency.

As adoption increases of NVMe over Fabrics integrated with Gen6 Fibre Channel, the technology can realize additional gains by taking advantage of 128 Gbps Parallel Fibre Channel, also part of the Gen6 standard. Parallel Fibre Channel stripes four 32 Gb Channels into a single high-speed link that uses a Quad Small Form-factor Pluggable (QSFP) connector. Support for enabling Parallel FC into a future Brocade Fabric OS® release is already designed into HPE StoreFabric Gen6 Fibre Channel switches and will enable the fastest connectivity option available to a high-speed storage device.





Summary

Data centers are recognizing the value proposition for all-flash and flash-enhanced storage, not only to support niche applications, but also for mixed workloads that include production and business-critical applications. HPE Smart SAN for 3PAR automatically orchestrates the tedious nature of SAN zoning in minutes, not hours, and error-free, resulting in faster host provisioning for all-flash deployments with Gen6 and Gen5 fabrics. HPE StoreFabric Gen6 Fibre Channel and HPE StoreFabric Power Pack+ with IO Insight complement and enhance the value of flash storage by ensuring maximum throughput and lowest latency. In addition, Gen6 feature enhancements such as IO Insight's deeper visibility into the IO performance of the storage infrastructure ensures the consistently highest level of performance and system utilization. A Gen6 network infrastructure incurs a small incremental price that enables consolidation of servers, storage infrastructures, and maximized performance and utility, which pay significant dividends on an investment in flash-enhanced storage.

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