

Benefits of Gen 6 Fibre Channel for the All-Flash Data Center

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Introduction

Embracing the digital transformation and taking advantage of new technologies such as flash and next-generation NVMe over Fibre Channel is a critical factor for success in any IT organization. But to reap the full benefit from these investments requires modernizing the storage network. This paper discusses key trends and technology advancements, and explains how Brocade® Gen 6 Fibre Channel with Brocade Fabric Vision® technology delivers the application performance, operational stability, and business agility needed to modernize the network and meet current and future flash-based storage requirements.

Business leaders are embracing the digital transformation as a critical factor for success, and they expect IT to help them innovate faster, increase profitability, and gain competitive advantage. But digital transformation is putting new pressure on IT organizations and pushing mission-critical IT storage environments to the limit. Faced with exponential data growth, hyperscale virtualization, evolving workloads, and new demands for always-on business operations, the IT storage infrastructure must evolve to enable businesses to thrive in this new era. Legacy infrastructure was not designed to support today's pace of business and growing business requirements. IT organizations need to modernize the data center and deploy a storage infrastructure that can deliver greater consistency, predictability, and performance.

Fortunately, innovation for the storage network is well underway. The newest and most exciting storage advancement today is flash-based storage. The unprecedented speed and rapidly increasing cost-effectiveness of flash-based products are dramatically accelerating data center transformation. And now, next-generation flash storage based on Non-Volatile Memory Express (NVMe) over Fibre Channel will provide even greater value through significant performance gains.

To take full advantage of flash storage, innovation for the storage network is also required. As companies redefine application performance with flash storage, they require networks that deliver ultra-low latency, higher capacity bandwidth, and greater reliability. In fact, an aging network will bottleneck the performance of an all-flash data center.

30 BILLION

Transactions go through
Fibre Channel per day

96%

World's banks, airlines and
retails run over Fibre Channel

Brocade Gen 6 Fibre Channel with Brocade Fabric Vision technology is the network innovation required for the virtualized, all-flash data center. Brocade Gen 6 Fibre Channel combines innovative hardware, software, and integrated network sensors, ensuring the industry's highest level of operational stability and redefining application performance. Brocade Fabric Vision technology enhances visibility into the health of storage environments, delivering greater control and insight to quickly identify problems and achieve critical Service Level Agreements (SLAs).

Breakthrough 32 Gbps performance accelerates application response time by up to 71 percent, eliminating IO bottlenecks and unleashing the full performance of flash and next-generation NVMe-based storage. In addition, with diverse deployment options and future-proof integration, organizations can seamlessly adapt, transform, and optimize their businesses to meet next-generation storage requirements based on NVMe over Fibre Channel.

Gen 6 Fibre Channel's automation technology transforms SAN management by simplifying operations and freeing up resources, allowing organizations to focus on business optimization and revenue opportunities. This technology

enables DevOps resources to quickly automate and orchestrate SAN resources through open APIs and the Ansible automation engine. With Brocade automation, organizations can reliably perform resource-intensive tasks, such as provisioning, and operationalize the continuous monitoring of the network, so that tasks can be completed in a fraction of the time, while eliminating human error.

By leveraging Brocade Gen 6 Fibre Channel, organizations can modernize their networks and optimize virtualized applications to take advantage of the full capabilities of a future-ready all-flash data center.

Network Innovation for the Virtualized, All-Flash Data Center

It is easy to understand the most obvious benefits of upgrading networking technology to increase the speed of data transfers and decrease the number of links and devices required to accomplish network tasks. Yet the question often arises of whether these higher levels of infrastructure performance and throughput are essential to an organization's network. The answer is a clear yes. New server and storage technology advancements such as flash-based storage are driving up storage network bandwidth demand well beyond current capabilities. In addition, requirements for higher-density server virtualization, new latency-sensitive applications, mixed/dynamic workloads, and overall application growth all are placing unprecedented demands on the network.

Flash-based storage is driving exponential advances in storage, enabling faster block- and file-based storage performance for high-density virtualized workloads and traditional mission-critical applications. As a result, many enterprises are moving to an all-flash environment

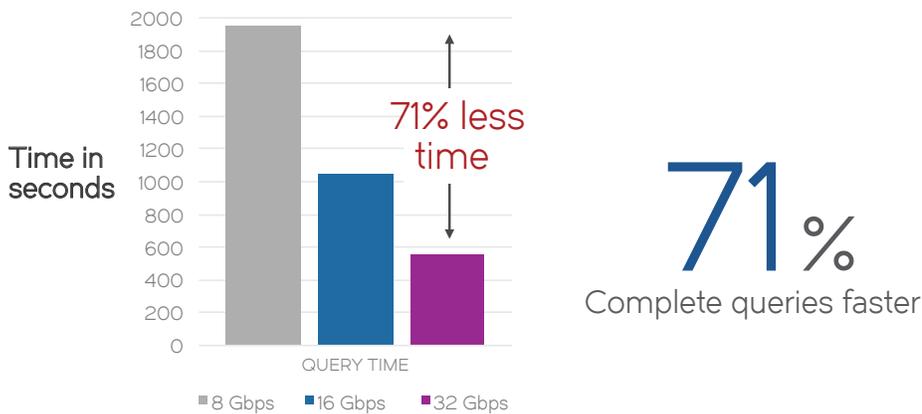
to eliminate performance issues and scalability challenges. This move, however, drives the need for higher IO bandwidth performance and greater availability from the storage network. Next-generation NVMe over Fibre Channel will place even greater demands on the network.

Demartek testing of a data warehousing application workload shows that even when using an all-flash array with 8 Gbps target ports, substantial improvements in application performance can be achieved by upgrading the network to 32 Gbps with Gen 6 Fibre Channel—without requiring any changes to the target storage system.¹ The test results highlighted that, completion time was a full 71 percent less with Gen 6 Fibre Channel compared to a legacy 8 Gbps network, enabling faster decision-making and offering substantial business value (see Figure 1).

Whereas the breakthrough application performance and throughput delivered by Gen 6 Fibre Channel are mandatory to meet these performance requirements and fully leverage these new flash storage capabilities, they are also crucial to address requirements for greater availability and predictability from the storage network.

Brocade Gen 6 Fibre Channel addresses such requirements by going beyond performance to offer a variety of unique innovations delivered through the Gen 6 Fibre Channel Application-Specific Integrated Circuit (ASIC), in combination with Brocade Fabric OS® (FOS) and Brocade Network Advisor. Together, these new capabilities enhance operational stability and increase business agility, providing the mission-critical foundation required to support always-on business operations and to seamlessly integrate next-generation storage.

¹ Emulex/Broadcom* TPC-H benchmark testing: See http://www.demartek.com/Demartek_Emulex_LPe32000_Gen6_FC_Evaluation_2016-03.html.



Connectivity to 8 Gbps flash storage

Figure 1: Accelerate 8 Gbps flash storage with 32 Gbps networking.

Brocade Unique Innovation

The unparalleled bandwidth, scale, and performance of Brocade Gen 6 Fibre Channel are not sufficient on their own to meet the demands of customers who manage a mission-critical IT infrastructure. The drivers behind the bandwidth and performance gains provided by Gen 6 Fibre Channel, such as higher-density virtualization and flash storage, also require that they are deployed easily and operated consistently—with low OpEx. The ability to simplify management, provide deep and granular visibility into storage performance, accelerate troubleshooting, and enable performance optimization is essential to ensure operational consistency and stability for any large-scale environment.

Unprecedented Visibility into Storage and Individual VM Performance

Brocade Gen 6 Fibre Channel offers several breakthrough technologies that go beyond throughput performance to enhance operational stability and increase business agility. One of the key capabilities, Brocade Fabric Vision technology, provides unprecedented visibility and insight across the storage network, through powerful monitoring, diagnostic, and management tools that

dramatically increase uptime, optimize performance, and reduce costs.

New with Gen 6 Fibre Channel, Brocade, A Broadcom Inc. Company, extends Brocade Fabric Vision technology with IO Insight and VM Insight capabilities to increase operational stability. IO Insight and VM Insight leverage ground-breaking integrated sensors for monitoring storage IO and Virtual Machine (VM) performance to help organizations achieve greater visibility into device and VM-level application performance. This enhanced visibility enables quick identification of degraded application or VM performance from a storage fabric, reducing time to resolution. Using integrated sensors, this capability allows administrators to monitor application and VM performance and latency statistics to quickly identify abnormal behaviors. This facilitates troubleshooting and fault isolation, as well as provides intelligence for early detection of application performance degradations, to help ensure that critical SLAs are met. IO Insight and VM Insight extend and complement automated monitoring, diagnostic, and management capabilities enabled by Fabric Vision. In addition, integrated sensors enable organizations to avoid dependence on invasive and disruptive physical taps.

IO Insight

IO Insight proactively monitors IO performance and behavior to provide unparalleled insight into problems and to ensure service levels. This capability non-disruptively and non-intrusively gathers IO statistics from any device port, then feeds them to a monitoring policy that sets thresholds and generates alerts. Administrators can use this proactive monitoring of SCSI or NVMe traffic to gain key insights so they can quickly identify problems and accelerate root-cause analysis for faster time-to-resolution, enabling them to maintain optimal network health and performance. With IO Insight, administrators can baseline their performance profiles for IOs and storage latency. In addition, they can use the monitoring capability and activity dashboards provided by Brocade Monitoring and Alerts Policy Suite (MAPS) to quickly identify latency spikes in IO. For activity that does not comply with expected behavior, preventative actions can be defined—ranging from notifications to port fencing—to prevent greater negative impact (see Figure 2).

IO monitoring allows greater insight into storage performance and provides demonstrable evidence of achieving critical SLAs. IO Insight enables proactive IO monitoring of:

- 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 IOs in the queue, maximum and average

By coupling IO Insight with the built-in monitoring, management, and diagnostic tools of Brocade Fabric Vision technology, IT organizations can make more intelligent resource allocation decisions, which helps them more effectively manage operational objectives and ensure optimal performance across the storage network.

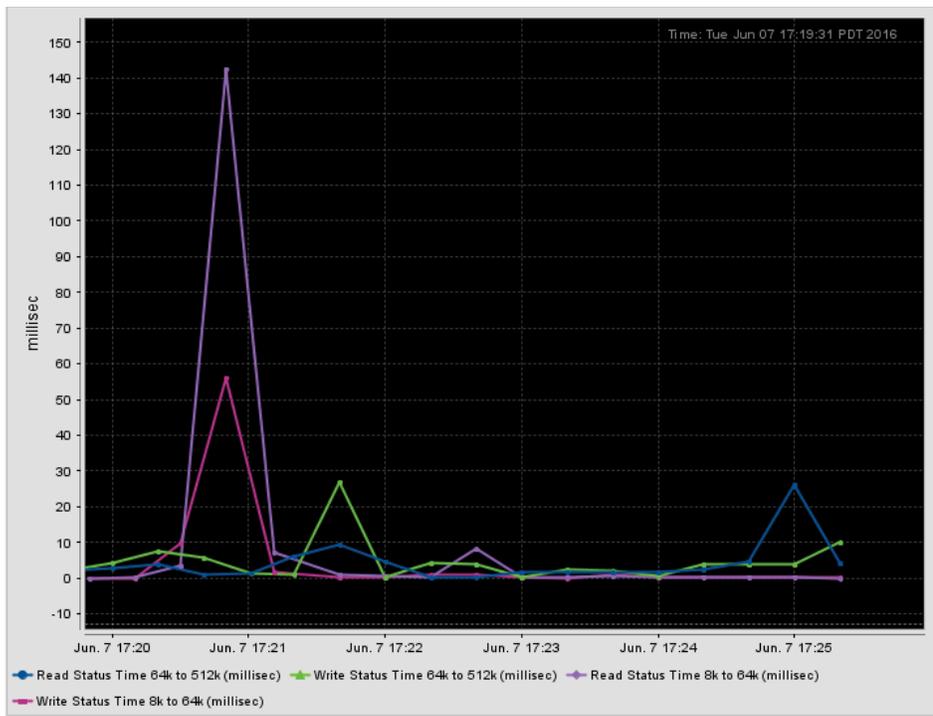


Figure 2: IO Insight metrics displayed in a Brocade Network Advisor real-time performance graph.

Brocade Network Advisor 14.0.1 supports the IO Insight metrics displayed in the Flow Vision real-time performance graph. The screen capture in Figure 2 displays the IO Insight metrics for a flow. Administrators can save this performance graph as a widget and add it to the Brocade Network Advisor dashboard for an at-a-glance performance view of the important IO flows.

VM Insight

A lack of visibility into VM-level performance metrics across the SAN places an additional burden on administrators when they try to enforce SLAs—as they cannot identify VMs in the storage fabric. Brocade has extended Fabric Vision with VM Insight integrated sensors to help organizations achieve greater visibility into VM-level application behavior. VM Insight delivers unparalleled end-to-end visibility into the storage performance of individual VMs to optimize VM performance and availability in a virtualized data center. VM Insight uses

standards-based VM tagging to enable monitoring of VM-level performance issues in a Gen 6 Fibre Channel SAN. Using this information, storage administrators can establish baseline application performance behavior and quickly identify anomalies to fine-tune the infrastructure and to meet service-level objectives. VM Insight also enables quick correlation with other Fabric Vision metrics to identify the root cause of problems before operations are affected.

Increased Productivity with Automation

The rapid pace of innovation in the data center is increasing the complexity of managing the infrastructure. More time is spent on deployment, configuration, and troubleshooting tasks to maintain service-level agreements and keep up with demands. IT organizations spend nearly half of their time performing repetitive daily management tasks, such as zoning, inventory reporting, and operational validation checks. Brocade automation is

powerful for DevOps, simple with Ansible and open for communities. It leverages open-source technology to automate and orchestrate repetitive tasks, enabling IT organizations to significantly improve their efficiency and decrease the risk of operational mistakes. Automation in large-scale IT environments integrates diverse infrastructure components with consistency and predictability to deliver greater operational efficiency and agility. With more than 20 years of storage networking experience, Brocade understands the nuances that go into infrastructure management and what tasks can benefit from automation. By introducing REST APIs directly into its switch and management products, Brocade offers a broad range of choices to enable any SAN management solution. IT organizations that combine Brocade's automation with orchestration tools (such as Ansible) gain the ability to automate configuration tasks and to monitor and detect any performance or health changes. In turn, these automation tools dramatically increase the amount of infrastructure that any single administrator can manage, thus freeing up resources for higher-value tasks.

Brocade automation solutions are based on these pillars:

- REST APIs are available directly from the switch automates repetitive daily tasks, such as fabric inventory, provisioning, and operational state monitoring
- Open-source PyFOS, a Python scripting language, simplifies common SAN management practices
- Ansible integration enables automation and orchestration across the entire infrastructure

Simplified Management and Accelerated Deployments

Brocade Network Advisor simplifies Gen 6 Fibre Channel management and helps organizations dramatically reduce deployment and configuration times by allowing fabrics, switches,

and ports to be managed as groups. Customizable dashboards graphically display performance and health indicators out of the box, including all data captured using Brocade Fabric Vision technology, IO Insight, and VM Insight. To accelerate troubleshooting, administrators can use dashboard playback to quickly review past events and identify problems in the fabric. Dashboards and reports can also be configured to show only the most relevant data, enabling administrators to more efficiently prioritize their actions and maintain network performance.

Brocade Network Advisor provides organizations with a programmable Web-based interface through a standard Representational State Transfer Application Programming Interface (REST API) that reduces operational tasks by automating zoning, scripting, and reporting. To further simplify management tasks, administrators can quickly search through events, historical data, and base

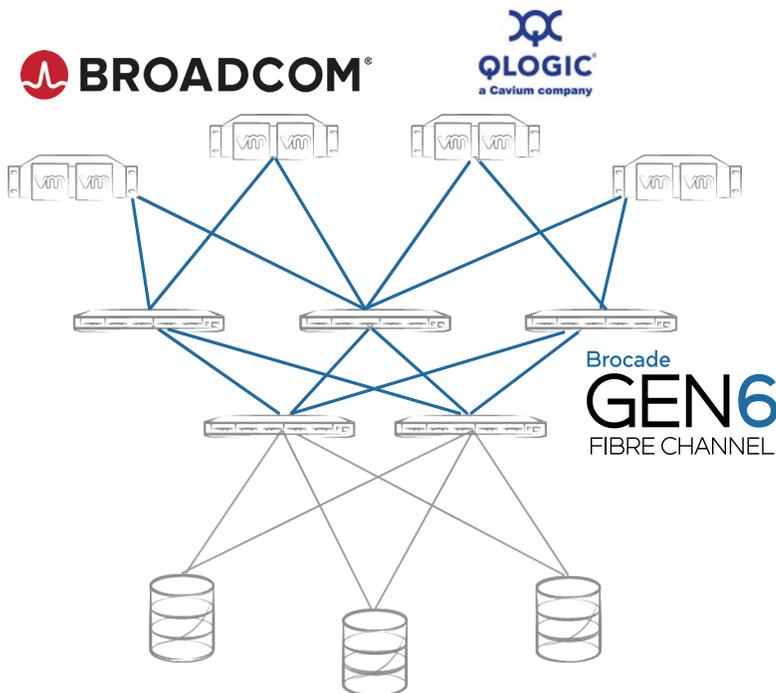
inventory, and apply filters. In addition, the standard REST API leverages Brocade Fabric Vision technology to gain fabric-wide health and performance visibility via easy-to-read dashboards.

Brocade simplifies management further by integrating with leading Host Bus Adapter (HBA) vendors. Through this sharing of technology, Brocade Gen 6 Fibre Channel with Fabric Vision technology is able to simplify and accelerate server deployments, ensure predictable performance across both the server and storage IO infrastructure, consolidate and simplify end-to-end management, and quickly identify and isolate optics and cable problems (see Figure 3).

Together with its HBA partners, Brocade helps organizations increase business agility by offering enhanced, end-to-end storage network stability and predictability, optimized performance, and flexibility.

Multiprotocol Replication over Distance

Leveraging the purpose-built, highly scalable Brocade SX6 Extension Blade for Fibre Channel, FICON®, and IP storage replication, administrators can accelerate data replication over distance to meet recovery objectives and secure data flows at full line-rate speed without compromising performance. With industry-leading port density and with up to 80 Gbps application throughput per blade, as well as unique multiprotocol and bandwidth optimization technology, this Brocade Gen 6 Fibre Channel and IP replication solution moves data faster and easily scales to support the world's most demanding environments. It delivers business resiliency at scale with 32 Gbps Fibre Channel and 1/10 Gigabit Ethernet (GbE) IP storage replication over 1/10/40 GbE IP Wide-Area Network (WAN) connections to handle the unremitting growth of data traffic between



- Simplify server deployment
- Ensure predictable performance
- Consolidate and simplify management
- Identify and isolate optics and cable problems

Figure 3: HBA integration with Brocade Gen 6 Fibre Channel.

data centers. To ensure non-stop operations, the Brocade Gen 6 replication solution delivers holistic management through Brocade Fabric Vision technology, providing greater control and insight, and simplifying troubleshooting of end-to-end IO flows over distance.

Close Integration with Mainframe

Brocade builds on more than 20+ years of mainframe leadership to deliver the industry's highest performance and most reliable and scalable FICON infrastructure. With seamless FICON connectivity for mainframe storage environments and support for innovative features that only Brocade can offer—including ClearLink® D_Port, Fabric IO Priority, FICON Dynamic Routing, Gen 5 and Gen 6 Fibre Channel Forward Error Correction (FEC), and Inter-Switch Link (ISL) Encryption—organizations can achieve the full potential from new IBM z13 and z13S mainframe investments.

Flexible Deployment Options

The Brocade Gen 6 portfolio offers flexible deployment offerings to help organizations maximize their infrastructure, increase business agility, and enable scalability on demand. The Brocade X6 Director, for instance, is available in two modular form factors, the Brocade X6-8 and X6-4. This modular chassis design increases business agility with two optional blades to seamlessly deliver storage connectivity and support disaster recovery and data protection storage solutions over long distances. Brocade X6 Directors offer reversible air flow, providing organizations with more cooling deployment options. These new options—allowing non-port-side intake to port-side exhaust or port-side intake to non-port-side exhaust—offer additional deployment flexibility and operational efficiency.

Deployment flexibility is also available with the Brocade G620 Switch. The Brocade G620 provides the industry's highest port density solution in a compact 1U form factor, along with pay-as-you-grow scalability with its 24 to 64 ports, for

on-demand flexibility. The switch also comes with four Q-Flex ports—with each port able to support either 4x32 Gbps or 128 Gbps speeds for ISL or device connectivity—providing unmatched deployment flexibility and the ability to transparently meet changing connectivity requirements.

Brocade Gen 6 Fibre Channel in Action

Brocade Gen 6 Fibre Channel delivers industry-leading 32 Gbps performance to accelerate data access without oversubscription. With Brocade Fabric Vision technology, Brocade Gen 6 Fibre Channel provides a more stable, predictable network and the transparent adaptability to meet next-generation storage requirements.

Benefits of Brocade Gen 6 Fibre Channel include:

- Breakthrough application performance
- Enhanced operational stability
- Increased business agility

Breakthrough Application Performance: The Need for Speed

Performance matters for critical applications, demanding workloads, and flash-based storage architectures. Gen 6 Fibre Channel delivers the throughput and low latency needed to meet these new and evolving server and storage performance requirements. The following use cases highlight the benefits of Brocade Gen 6 Fibre Channel.

Application Growth Use Case

The source of major growth in all computing environments is the increasing size and number of software applications and workloads that are considered Tier 1, mission-critical. Large and growing databases, virtual server environments with mixed workloads, and servers are putting tremendous strain on the existing infrastructure, driving greater storage capacity and bandwidth requirements.

Gen 6 Benefit: Brocade Gen 6 Fibre Channel with 32/128 Gbps links dramatically increases IO performance and throughput to complete workloads faster, while providing a highly scalable infrastructure that supports massive application growth.

Higher-Density Server Virtualization Use Case

Virtual Machine (VM) densities (the number of VMs hosted on each physical server) continue to rise from 10 to 20 VMs to 40 to 50 VMs per physical server—all booting from the Storage Area Network (SAN) and accessing SAN resources. Increased density of VMs is enabled by new, more powerful 16+ core servers, Peripheral Component Interconnect express (PCIe) Gen 3 technology running at 256 Gbps, and terabytes of RAM that allow VMs and applications to run at their full potential, driving demand for higher performance (bandwidth and IO).

Gen 6 Benefit: The higher throughput delivered by Brocade Gen 6 Fibre Channel supports double the VM density of Gen 5 Fibre Channel, providing greater server utilization and ensuring optimized performance for high-density VM deployments. Leveraging the 128 Gbps links, Gen 6 Fibre Channel offers up to 8X the bandwidth compared to Gen 5 Fibre Channel, enabling full utilization of today's more powerful server and IO infrastructures, as well as scalability for the growing VM environment.

Deploying new infrastructure

Exponential data growth and evolving workloads, are demanding business to deploy new infrastructure to support today's business requirements. In order for IT organizations to modernize their data center quickly, they must be able to simplify operations and free up resources to focus on business optimization and revenue opportunities.

Gen 6 Benefit: With Brocade automation, organizations can quickly and reliably perform resource-intensive tasks, such as provisioning and operationalizing the continuous monitoring of the network, so that tasks can be completed in a fraction of the time. Brocade Gen 6 platforms feature integrated REST APIs directly into the switch and management products and they enable IT organizations to leverage Brocade industry-expertise to deliver seamlessly automated provisioning, configuration, and management across the Fibre Channel network infrastructure.

Flash Storage Use Case

Recent flash technology advancements enable scalability of up to hundreds of terabytes in a compact form factor, and faster flash arrays are now capable of millions of IOPS, further accelerating application performance. To make flash even more attractive, the cost of flash has dropped considerably. For these reasons, many enterprises are moving to an all-flash environment to eliminate performance issues and scalability challenges. This move, however, drives the need for higher IO bandwidth performance, and it will only increase with flash storage based on NVMe over Fibre Channel.

Gen 6 Benefit: Breakthrough Gen 6 Fibre Channel performance accelerates application response time by up to 71 percent, eliminating IO bottlenecks and unleashing the full performance of flash and next-generation NVMe-based storage.

High-Performance OLTP Use Case

Online Transaction Processing (OLTP) is foremost about optimizing speed. High-performance OLTP transactions require higher IOPS and lower latency than currently available, to accelerate application response time and complete the workload faster in order to generate more revenue. The infrastructure must also be highly scalable to meet

requirements during peak periods and support application growth.

Gen 6 Benefit: In addition to completing workloads 71 percent faster, Gen 6 Fibre Channel delivers lower latency and faster application response time for demanding application workloads. In the Demartek benchmark testing, the data warehouse workload query time and latency for both target and initiator were cut almost in half compared to Gen 5 Fibre Channel.² Speeding up data-intensive application response times allows more transactions to be completed in less time and improves service levels while providing a highly scalable infrastructure to support peak loads. Revenue-producing OLTP workloads will benefit by generating more revenue for the business and ensuring that customer service SLAs are met.

High-Resolution Video Use Case

With the advent of faster frame rates, 4K, and 8K resolution, the amount of digital data created has grown by an order of magnitude almost overnight. The result for post-production editors is that real-time video editing is now bottlenecked by a legacy SAN infrastructure deployed to support historical performance requirements.

Gen 6 Benefit: Brocade Gen 6 Fibre Channel removes the SAN bottleneck and provides 32/128 Gbps line-rate performance on every port to support 4K and 8K video editing.

Replication over Distance Use Case

IT organizations continue to be challenged with effectively managing the growing amount of data that needs to be replicated between data centers. Not only is the amount of data growing, the type of workloads and application data that need to be protected is expanding beyond the traditional Fibre Channel/FICON block storage to include more business-critical IP-based storage data. The storage network must be able to scale to move more data faster over any distance.

Gen 6 Benefit: The Brocade purpose-built, highly scalable Gen 6 Fibre Channel and IP extension solution accelerates data replication to meet recovery objectives and secure data flows over distance at full line-rate speed—for 50 times higher throughput than native IP storage replication.

In order to deliver the promised breakthrough application performance required by these server and storage infrastructures, Brocade Gen 6 Fibre Channel is closely integrated with—and has deep ecosystem support from—HBA vendors. Leveraging the rich feature set of Gen 6 HBAs, together with the breakthrough performance of Gen 6 Fibre Channel switches, administrators can ensure Quality of Service (QoS) for critical applications.

IO INSIGHT AND VM INSIGHT FOR ALWAYS-ON BUSINESS

- *Monitor storage IO and VM health and performance to maintain SLA compliance*
 - *Identify IOs and VMs that deviate from expected behavior to facilitate fault isolation and troubleshooting*
 - *Tune device configurations with integrated IO and VM metrics to optimize storage performance*
-

Enhanced Operational Stability: Driving Always-On Business

The digital transformation requirements go beyond performance, however. Required service levels continue to rise, with users expecting data to be accessible from anywhere, at any time, on any device, instantly. The goal is no downtime, ever. The use of virtualization, flash storage, and automation tools has allowed applications and services to be deployed faster and shatter performance expectations. But the unprecedented number of application and service interactions has also increased

² http://www.demartek.com/Demartek_Emulex_LPe32000_Gen6_FC_Evaluation_2016-03.html.

the complexity, risk, and instability of the overall infrastructure. As a result, getting actionable intelligence about any performance issues across the storage network is critical for delivering stable operations.

Brocade goes beyond Gen 6 Fibre Channel standards to deliver the innovations and capabilities needed to meet these new requirements, enhancing operational stability and providing the foundation required to enable always-on business operations. Brocade Gen 6 Fibre Channel with Brocade Fabric Vision technology, IO Insight, and VM Insight gives data center administrators the needed visibility into application performance to ensure SLA compliance, quickly troubleshoot performance problems, and optimize storage performance. These use cases are discussed below.

Storage Performance SLAs Use Case

When administrators are responsible for guaranteeing a certain level of performance and application response time in the SLA to their customer, throughput and latency are often the key metrics they use. For instance, in an environment with mixed storage arrays that support mixed workloads, administrators may be required to guarantee that latency for IO operations is under 25 milliseconds, to ensure adequate application response. For specific latency-sensitive applications that are provisioned on all-flash arrays, latency must be under five milliseconds.

Gen 6 Benefit: The built-in capabilities of Brocade Fabric Vision technology with IO Insight and VM Insight non-disruptively and non-intrusively collect the IO and VM metrics needed to ensure SLA compliance. Administrators can simply define which data flows they want to monitor using Flow Monitor, import the flows into the Brocade Monitoring and Alerts Policy Suite (MAPS) with the required latency thresholds, and proactively monitor those flows to ensure

compliance. If the required latency threshold is violated, administrators are notified to take early action before customers request support. Reports can also be generated to track SLA compliance over time.

Storage Performance Troubleshooting Use Case

When applications experience IO-related performance problems such as slow response, time outs, or even a crash, administrators are under great pressure to resolve the issues quickly. Because there are many components in a storage network that can impact performance, the administrator must first try to isolate the root cause of the problem, whether it is within the fabric or a storage device or if the culprit is a slow-drain host. Uncovering the root cause of the performance issue can be extremely difficult and time-consuming.

Gen 6 Benefit: Brocade Fabric Vision technology with IO Insight and VM Insight is able to quickly—with just a few commands or mouse clicks—identify the root cause of performance issues. With Flow Monitor, data flows can be defined on storage ports to obtain the latency and performance metrics of storage devices. If metrics are abnormal, it is very likely that the problems are due to the storage device itself, rather than the fabric. If the metrics are within normal range, the problems are most likely within the fabric or coming from the hosts. With Brocade Gen 6 platforms, administrators can then further troubleshoot by defining a flow on the host ports. If the metrics are within normal range, then the problem is probably a host-side issue. If the metrics are abnormal, problems within the fabric or a slow-draining host are likely causing the slow response. Administrators can also confirm whether the host is a slow-drain device by correlating with Fabric Performance Impact (FPI) Monitoring from Brocade. If not, it is likely that fabric congestion is negatively impacting performance of the flow. The IO and VM performance metrics provided by

IO Insight and VM Insight dramatically accelerate troubleshooting performance issues, helping organizations avoid disruption to operations and reducing costs.

Storage Performance Optimization Use Case

The demand has dramatically increased for a large-scale storage network with optimal performance delivered consistently and with operational stability. However, to ensure that optimal performance is consistently delivered cost-effectively requires in-depth intelligence and IO metrics.

Gen 6 Benefit: Brocade Fabric Vision technology with IO Insight and VM Insight can also be used to optimize the performance of a storage infrastructure. For latency-sensitive applications, administrators can use IO Insight metrics to directly measure IO latency to any given storage target from the host to help make informed decisions about provisioning and deploying applications. Administrators can also use IO Insight metrics to tune and optimize the overall network connecting the hosts and storage. By using IO metrics in conjunction with the physical infrastructure connectivity design, administrators can quickly determine whether configuration settings such as queue depth are properly set to ensure optimal performance for latency-sensitive, mission-critical applications as well as less critical applications. With VM Insight, administrators can leverage IO Insight and network throughput metrics to gain end-to-end visibility into the performance of individual VMs.

Leveraging Brocade Gen 6 Fibre Channel with Brocade Fabric Vision technology, IO Insight, and VM insight, IT organizations will have the predictable application performance they require, as well as unprecedented visibility and insight into highly virtualized application data flows, simplifying management and meeting their always-on business requirements.

BROCADE GEN 6 FIBRE CHANNEL

Brocade Gen 6 Fibre Channel offers the industry's broadest storage connectivity and deployment offerings to meet evolving storage requirements, both today and tomorrow. Brocade Gen 6 increases business agility by allowing organizations to:

- *Integrate seamlessly next-generation NVMe over Fibre Channel with Gen 6 Fibre Channel networks without a disruptive rip and replace*
- *Mitigate risk with backward-compatibility to existing infrastructure, while protecting investments with Gen 7-ready storage networking infrastructure*
- *Extend replication over distance with a highly scalable extension solution for Fibre Channel, IP, and FICON*
- *Deliver seamless FICON connectivity for mainframe storage environments*
- *Gain operational efficiency with flexible cooling deployment options*
- *Reduce power consumption by 28 percent, saving power for new data center components*

Other features of Brocade Fabric Vision technology—such as FEC at 16 Gbps, ClearLink Diagnostics, and Virtual Channel (VC)-level Credit Loss Recovery—enhance reliability, enable easy pre-deployment testing and post-deployment troubleshooting, and protect against performance degradation due to physical link-level issues. These capabilities lead to greater overall operational stability.

Increased Business Agility: Adapting and Optimizing Business

To realize the full benefits of flash storage, organizations will be transitioning their high-performance, latency-sensitive

workloads to flash-based storage with next-generation NVMe over Fibre Channel. The simplicity and efficiency of NVMe enables significant performance gains for flash storage. Moreover, NVMe enables users to achieve faster application response times and harness the performance of hundreds of SSDs for better scalability across virtual data centers with flash.

Organizations can seamlessly integrate Brocade Gen 6 Fibre Channel networks with next-generation NVMe without a disruptive rip and replace. By leveraging the efficiency of NVMe, combined with the high performance and low latency of Brocade Gen 6 Fibre Channel, organizations can accelerate IOPS to deliver the performance, application response time, and scalability needed for next-generation data centers. NVMe over Fibre Channel is already moving forward and will provide the required networked storage to make clustering and VM mobility a reality.

For investment protection, Brocade offers three generations of backward-compatibility support for connectivity to 4, 8, and 16 Gbps Fibre Channel products. Furthermore, the Brocade X6 Director supports future Fibre Channel generations as a Gen 7-ready storage networking platform, allowing current Gen 6 and future-generation switch blade modules to be added to the chassis.

Summary

Data center modernization starts with Gen 6 Fibre Channel, but modern networks for the all-flash data center need more than just higher throughput and lower latency. Brocade Gen 6 Fibre Channel delivers the enhanced operational stability,

increased business agility and automated operations required to thrive in the new modern data center. Innovations from Brocade, such as Brocade Fabric Vision technology with IO Insight and VM Insight, ensure a consistent, predictable, and highly scalable foundation that organizations can use to optimize their businesses and seamlessly adapt to meet next-generation requirements for flash storage optimized by NVMe over Fibre Channel. Moreover, the addition of automation technology to Gen 6 Fibre Channel transforms SAN management by simplifying operations and freeing up resources to focus on business optimization and revenue opportunities. Leveraging Brocade Gen 6 Fibre Channel, IT organizations can make sure today that their storage networks are adaptable and future-ready, optimizing virtualized applications and unlocking the full capabilities of the all-flash data center, both now and in the future.

About Brocade

Brocade networking solutions help organizations achieve their critical business initiatives as they transition to a world where applications and information reside anywhere. Today, Brocade is extending its proven data center expertise across the entire network with open, virtual, and efficient solutions built for consolidation, virtualization, and cloud computing.

Learn more at
www.broadcom.com/brocade.

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