TECHNICAL REVIEW

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Brocade Autonomous Self-healing SANs

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Abstract

This Technical Review by TechTarget's Enterprise Strategy Group demonstrates how Broadcom has leveraged a new Fibre Channel (FC) standard and collaboration between Brocade switches and Emulex HBAs (Brocade and Emulex are divisions of Broadcom) to deliver autonomous, self-healing SAN capabilities that minimize the application performance impact of SAN congestion.

Background

Data storage is playing a more strategic role in enterprise IT, as 55% of organizations agree that data is their business.[1] Driven by a need to extract increased value from data, organizations require increased performance from their storage systems and their storage networks. Performance was identified as a top block-storage challenge by 34% of organizations. It was the second most commonly identified block storage challenge, second only to the challenge of integrating with IT automation (35%, see Figure 1).

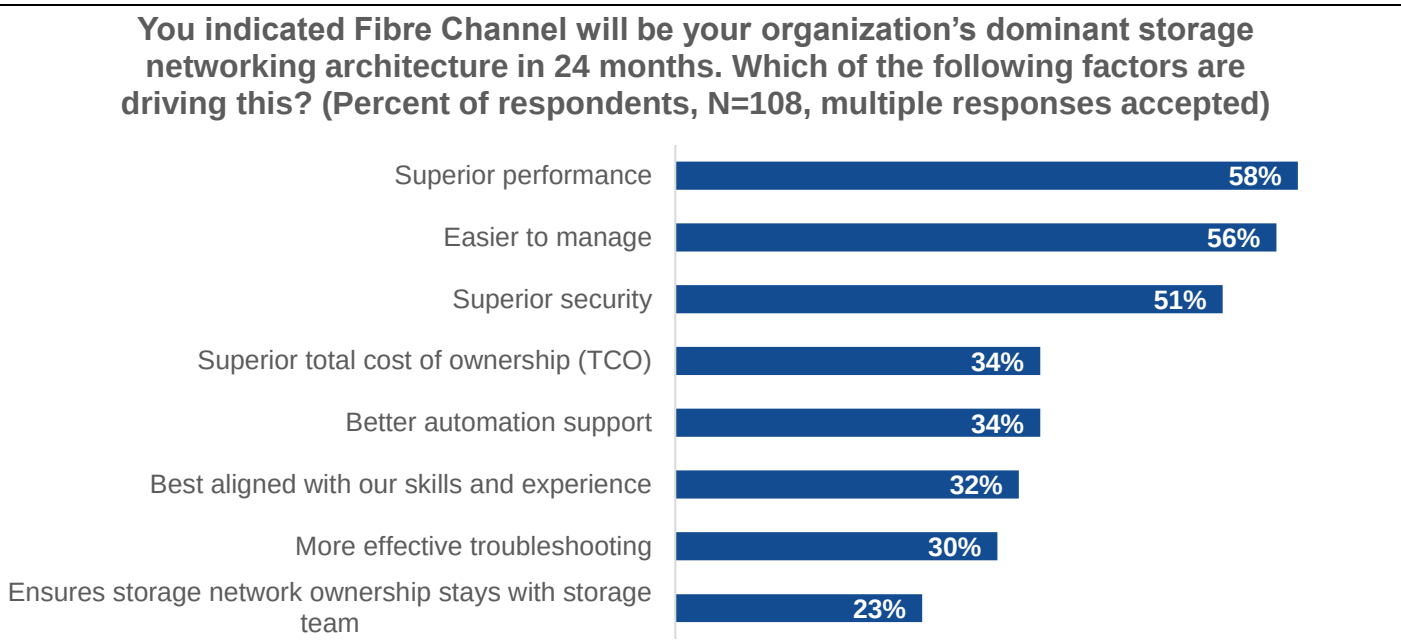
Figure 1. Data Storage Trends

Source: Enterprise Strategy Group, a division of TechTarget, Inc.

[1] Source: Enterprise Strategy Group Research Report, *Navigating the Cloud and AI Revolution: The State of Enterprise Storage and HCI*, March 2024. All Enterprise Strategy Group research references and charts in this technical review are from this survey results set.

In order to keep pace with an ever-increasing demand for data and the storage infrastructure required to support that data, organizations need access to better performance and better automation, which are among the top drivers of FC technology (see Figure 2).

Figure 2. Top Reasons Organizations Prioritize FC



Source: Enterprise Strategy Group, a division of TechTarget, Inc.

SAN congestion that impacts application-level performance is a hard problem to identify and fix. The lossless FC storage area network that sits between servers and storage systems is a shared resource that can get congested for a variety of reasons, including applications with high bursts of storage activity (aka "noisy neighbors") and accidentally oversubscribed SAN ports. The SAN congestion problem is getting worse for many organizations due to a perfect storm of new storage technologies and application workloads, including faster HBAs and SAN switches, all-flash storage arrays that are moving storage bottlenecks into SANs and servers, server virtualization, AI, and machine learning.

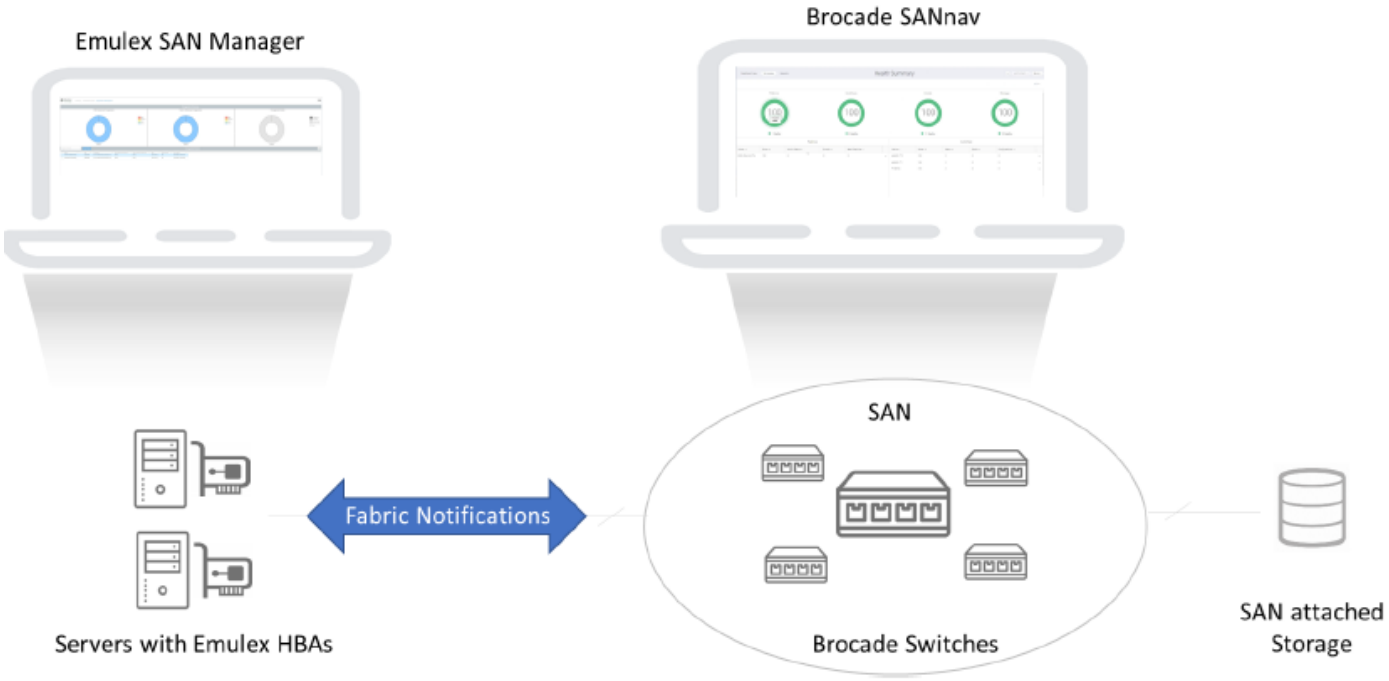
SAN congestion has historically been addressed with a heavy-handed approach, such as manually adjusting a queue depth limit in a host bus adapter driver or setting a hard performance limit with a quality of service (QoS) algorithm.

Autonomous Self-healing SAN Management

Broadcom's autonomous SAN self-healing capability detects and automatically fixes SAN congestion problems. Autonomous SAN technology is implemented in Brocade Fabric OS 9.0.x software and Brocade GEN 7 hardware that are equipped with the latest Brocade ASICs. Autonomous SAN technology is implemented in Emulex Gen 7 HBAs. A Brocade switch that has detected a SAN congestion issue uses the recently approved INCITS/T11 specification updates to include Fabric Performance Impact Notification (FPIN)[2] to tell Emulex HBAs which paths are congested and need to be remediated. As shown in Figure 3, Brocade switches and Emulex HBAs work together to detect, diagnose, and fix SAN congestion problems with FPINs.

[2] Fabric Performance Impact Notifications (FPINs) are defined by INCITS/T11.

Figure 3. Broadcom Autonomous Self-healing SAN Management



Source: Enterprise Strategy Group, a division of TechTarget, Inc.

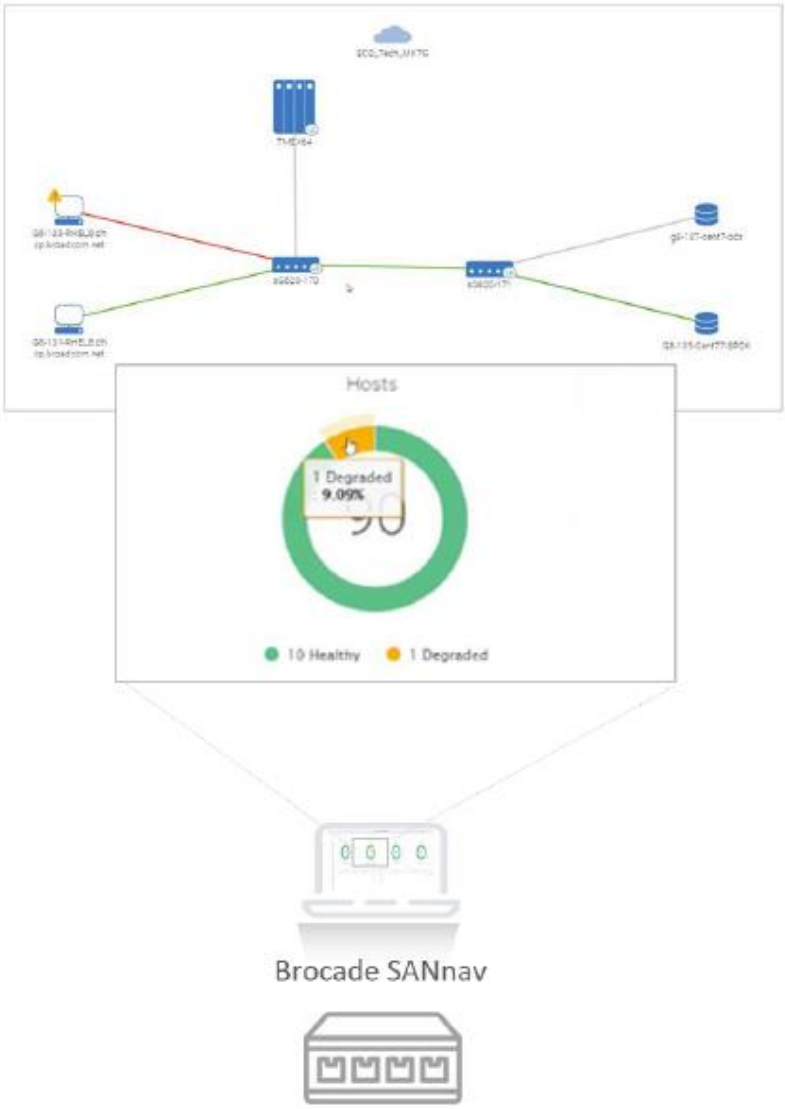
Enterprise Strategy Group Testing

Broadcom played a key role in the development of the FPIN specification. The motivation for this effort was simple: Broadcom customers consistently reported that finding and fixing SAN congestion problems was a top SAN management challenge.

Detecting SAN Congestion

SAN congestion was flagged as a problem through the Brocade SANnav Management Portal Health Summary score ring as an event that needed investigation. Brocade SANnav made it easy to visually investigate the error with a single click to drill down to explore the cause of the alerts. As shown in Figure 4, Brocade SANnav made it easy to detect SAN congestion and investigate which HBA ports and switch paths were fighting for bandwidth through the topology view. Once Brocade's switches detected and identified the congestion impact, the FPIN was sent to the end device, in this case the Emulex HBA.

Figure 4. Detecting SAN Congestion (Brocade SANnav Management Portal)

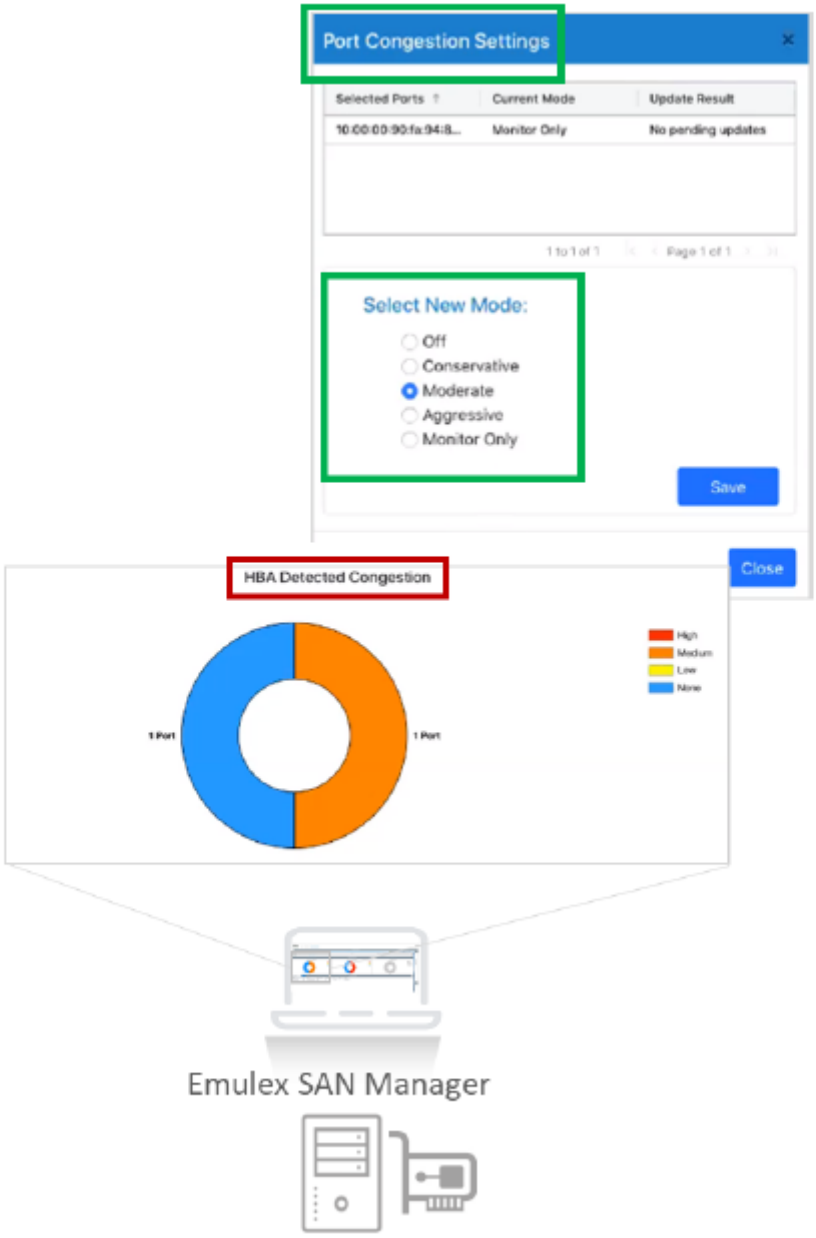


Source: Enterprise Strategy Group, a division of TechTarget, Inc.

Enabling Autonomous Self-healing

Next, Enterprise Strategy Group used the Emulex SAN Manager interface to visualize the FPIN notifications sent by Brocade switches, as shown toward the left in Figure 5. Enterprise Strategy Group then turned on a moderate level of port congestion management for the lower priority application. This setting, which was previously set to “monitor only,” tells the Emulex HBAs to slow down the lower priority “bully” traffic with a goal of eliminating the port congestion issue.

Figure 5. Enabling Autonomous Self-healing (Emulex SAN Manager)



Source: Enterprise Strategy Group, a division of TechTarget, Inc.

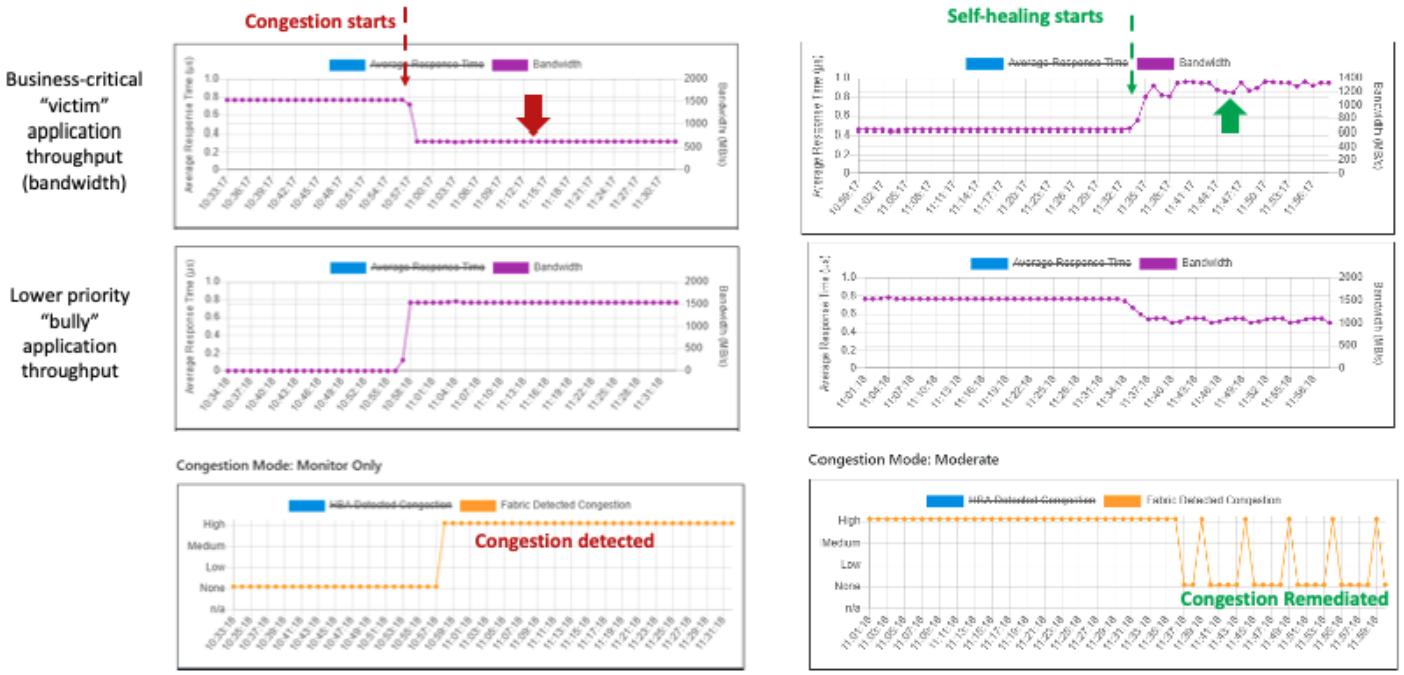
Enterprise Strategy Group noted that the autonomous SAN technology detected the SAN congestion issue in Brocade switches and used the FPIN protocol to notify Emulex HBAs about the congestion and to start using an adaptive congestion management algorithm to fix the problem. Slowing down a lower priority application with an adaptive congestion algorithm is a sophisticated approach for SAN congestion management compared to the legacy approaches of manually changing host adapter queue depth settings or using a QoS setting to set a hard performance limit for a lower priority application. The Broadcom self-healing approach doesn't require agents on the hosts, and it works with operating systems available today. The Broadcom self-healing approach is not only more sophisticated, but also operates without intervention in real time and constantly adjusts performance levels to maximize bandwidth usage if the congestion problem is transient.

Autonomous Self-healing in Action

Enterprise Strategy Group used both Brocade SANnav Management Portal and Emulex SAN Manager GUI to monitor performance and SAN congestion during each phase of the self-healing SAN test. As shown on the left in Figure 5, the business-critical data warehouse workload was running at approximately 1,500 MB/sec of sustained throughput before the lower priority backup job kicked in. Congestion was detected, as performance for the business-critical data warehouse workload dropped by more than 50%.

Autonomous self-healing is shown on the right in Figure 6. Note how business-critical performance picked up as the congestion algorithms were used to slow down the lower priority application. Also note how congestion remediation is happening in real time. Self-healing periodically kicks in to make real-time adjustments with a goal of providing a fair share of SAN bandwidth for lower priority applications if and when the congestion goes away.

Figure 6. Autonomous Self-healing in Action (Emulex SAN Manager)

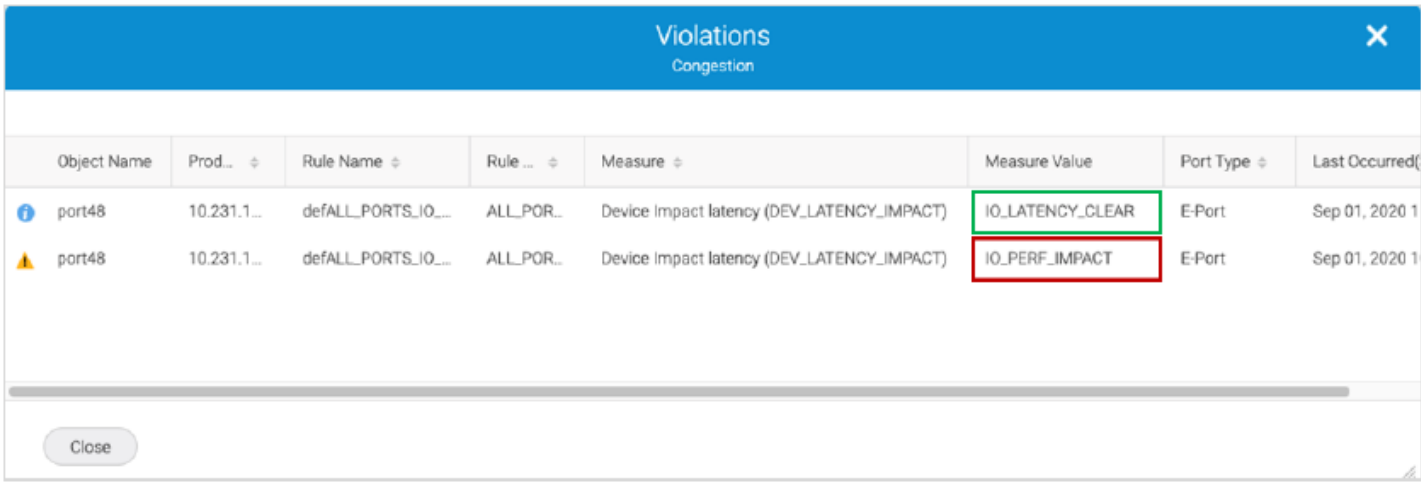


Source: Enterprise Strategy Group, a division of TechTarget, Inc.

Validating Autonomous Self-healing

Brocade SANnav Management Portal then indicated that the congestion impact had disappeared, and performance latency had gone back to normal. The original congestion violation message and the message that indicates that the congestion has been cleared are highlighted in Figure 7.

Figure 7. Validating Autonomous Self-healing (Brocade SANnav Management Portal)



Source: Enterprise Strategy Group, a division of TechTarget, Inc.

Why This Matters

SAN congestion that causes application performance problems is a notoriously hard problem to diagnose and fix. Slow application performance that is caused by (or mistakenly suspected to have been caused by) SAN congestion can lead to a loss of employee productivity, customer satisfaction, and revenue.

Finding, fixing, and automatically eliminating SAN congestion problems saves time and money for IT professionals and improves customer satisfaction and productivity for application users.

Conclusion

SAN congestion problems that block the flow of the data have been a challenge for IT organizations since the T11 technical committee first defined the FC standard in 1988. FC HBAs, switches, and drivers don't typically log errors that can be easily correlated to SAN congestion. The SAN is simply working overtime and needs to be monitored to see if, when, and where SAN congestion is happening. And more often than not, the application performance problem doesn't have anything to do with the SAN. After a SAN congestion problem has been detected and isolated, the traditional methods for fixing SAN congestion are manual and can't react quickly to changing traffic conditions.

Enterprise Strategy Group has validated that latest Brocade SAN Gen 7 switch hardware, Brocade Fabric OS version 9.0.x software, and Emulex Gen7 HBAs have leveraged the FPIN specification to automatically find and fix SAN congestion problems. Detecting and troubleshooting SAN congestion with Brocade SANnav Management Portal and displaying FPIN notifications with Emulex SAN Manager was intuitive and easy. Five minutes after enabling self-healing with a single mouse click, a "noisy neighbor" workload had been muted, and the performance of a business-critical data warehouse application had recovered.

Enterprise Strategy Group looks forward to seeing how customers respond to this new self-healing SAN capability. Any type of IT infrastructure change that introduces automation of an existing manual process is usually deployed with a touch of human observation and a set of approval processes. Broadcom's new SAN congestion

management feature can be turned off, left on in monitor mode only, or configured for autonomous self-healing. Based on the results of our validation testing, Enterprise Strategy Group believes that autonomous self-healing mode will be quickly embraced by IT, SAN, and storage administrators.

If your organization relies on an FC SAN to keep your business-critical applications running at peak performance levels, Enterprise Strategy Group believes that you should consider the IT productivity and bottom line business benefits of eliminating SAN congestion problems with Broadcom autonomous self-healing SAN management.

About Enterprise Strategy Group
TechTarget's Enterprise Strategy Group provides focused and actionable market intelligence, demand-side research, analyst advisory services, GTM strategy guidance, solution validations, and custom content supporting enterprise technology buying and selling.

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