



Investment Protection with Lenovo ThinkSystem Gen 6 Fibre Channel Products

June 2017



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HIGHLIGHTS

- Breakthrough 32 Gbps performance accelerates application response time by up to 71 percent, eliminating IO bottlenecks and unleashing the full performance of an all-flash data center.
- Seamlessly integrate next-generation NVMe over Fabrics with Gen 6 Fibre Channel networks without a disruptive rip and replace.
- Seamlessly connect older generation devices and storage networking equipment with three generations of backward-compatibility.
- Future-proof investments with a Gen 7-ready storage networking platform to meet evolving storage requirements.

The Modern Network for Tomorrow's Storage

Deployed in 90 percent of Fortune 1000 data centers, Fibre Channel (FC) is the de facto standard for mission-critical storage networking in the data center. As the recognized leader and innovator in storage networks, Brocade® Fibre Channel solutions are the most trusted, most deployed network infrastructure for enterprise storage. Brocade continues to drive future Fibre Channel open standards and technology advancements that deliver unparalleled business value.

Gen 6 Fibre Channel is the latest evolution in Storage Area Networks (SANs). Based on technology developed by the T11 technical committee that defines Fibre Channel interfaces, Gen 6 Fibre Channel is built to enhance the performance, reliability, scalability and security of SANs for flash-based storage technology, hyper-scale virtualization, and new data center architectures. Gen 6 defines speeds of 32 gigabits per second (Gbps) with single lane, doubling Gen 5 1600 megabytes per second (MB/sec) to 3200 MB/sec (32 Gbps) with Gen 6 Fibre Channel. The newly ratified 128 Gbps parallel Fibre Channel increases the data throughput of Gen 6 Fibre Channel links by 8X, from 1600 (MB/sec) in Gen 5 Fibre Channel to 12,800 MB/sec.

The benefits of faster networking technology are easy to understand. Data transfers are faster; fewer links are needed to accomplish the same task; fewer devices need to be managed, and less power is consumed when Gen 6 Fibre Channel is used. Several server and storage technology advances are pushing up demand for greater storage area networking bandwidth,

including application and storage capacity growth, high-density server virtualization, flash-based storage, and Non-Volatile Memory Express (NVMe) over Fabrics. Gen 6 Fibre Channel enables enterprise data centers to unleash the full potential of these and other advanced technologies.

The Lenovo ThinkSystem Gen 6 Fibre Channel Directors is available in two modular form factors. Built for large enterprise networks, the Lenovo ThinkSystem DB800D has eight blade slots for port and/or extension blades, to provide up to 384 device ports or 512 ports with device and Brocade UltraScale Inter-Chassis Link (ICL) ports. Built for midsize networks or edge connectivity, the 8U Lenovo ThinkSystem DB400D has four blade slots for port and/or extension blades, to provide up to 192 device ports or 256 ports with device and Brocade UltraScale ICL ports. The ThinkSystem Director family supports 4, 8, 10, 16, and 32 Gbps Fibre Channel, FICON, and 1/10/40 Gbps Fibre Channel over IP (FCIP) via two blade options, the Brocade FC32-48 Fibre Channel Blade and the Brocade SX6 Extension Blade. The Brocade FC32-48 provides 48 ports of 32 Gbps connectivity, and the Brocade SX6 provides sixteen 32 Gbps Fibre Channel ports, sixteen 1/10 Gigabit Ethernet (GbE) ports, and two 40-GbE ports to support disaster recovery and data protection storage solutions over long distances.

Higher throughput is important for keeping up with the many server and storage technology advancements, but the true value of ThinkSystem Gen 6 Fibre Channel technology goes well beyond faster links. Higher reliability and innovative breakthrough technologies—such as integrated network sensors (IO Insight), and Brocade Fabric Vision™ technology—provide powerful built-in monitoring, management, and diagnostic tools that enable organizations to simplify management, increase operational stability, and drive down operational costs.

Maximizing Infrastructure and Solution Flexibility

The previous generation of Gen 5 Fibre Channel is the proven network infrastructure for data center storage, delivering reliability, scalability, and 16 Gbps performance that customers have been migrating their fabrics to. Gen 5 was first available in summer of 2011, and since that time, the vast majority of customers have deployed Gen 5 Fabrics to support their critical applications.

Maximizing existing storage infrastructure investments while implementing next-wave storage technologies is top-of-mind for organizations. The need to move easily and without any

interruptions or problems is required. With the launch of next-generation Gen 6 Fibre Channel, customers are looking at how different generations of products will work together in their fabrics. ThinkSystem Gen 6 Directors enable organizations to both maximize their existing investments in Gen 5 storage infrastructure and to prepare their storage infrastructures for next wave of technologies, such as flash-based storage with NVMe over Fabrics. The ThinkSystem Gen 6 family enables that transition. It mitigates the risk with backward-compatibility to existing infrastructure while protecting investments with a future-ready storage networking infrastructure that seamlessly integrates next-generation flash storage with current and future Fibre Channel networks.

To realize the full benefits of flash, organizations will be transitioning their high-performance, latency-sensitive workloads to flash-based storage NVMe. The simplicity and efficiency of NVMe over Fibre Channel enables significant performance gains that take flash storage to new levels. NVMe over Fabrics technology enables end users to achieve faster application response times and harness the performance of hundreds of solid-state drives for better scalability across virtual data centers with flash. Customers can seamlessly integrate ThinkSystem Gen 6 Fibre Channel networks with next-generation NVMe over Fabrics flash storage. With the efficiency of NVMe over FC, combined with the high performance and low latency of ThinkSystem Gen 6 Fibre Channel solutions, customers can accelerate Input/Output Operations per Second (IOPS) to deliver the performance, application response time, and scalability needed for next-generation data centers.

Introducing Lenovo ThinkSystem Gen 6 into an Existing Gen 5 Fabric

A typical storage networking topology to optimize performance, management, and scalability is a tiered, core-edge topology. The core-edge topology places initiators (hosts or servers) on the edge tier and storage (targets) on the core tier. Since the servers and storage are on different switches, this topology provides ease of management as well as good performance, with most traffic traversing only one hop from the edge to the core. This approach provides predictable high performance with optimal interconnections.

The ThinkSystem Gen 6 platforms and Gen 5 Brocade DCX[®] 8510 platforms can use Brocade UltraScale ICL technology with optical Quad Small Form Factor (QSFP) connectivity. Both Gen

6 as well as Gen 5 8-slot chassis allow up to 32 QSFP ports, and both Gen 6 and Gen 5 4-slot chassis allow up to 16 QSFP ports to help preserve switch ports for end devices. Each QSFP port actually has four independent 16 Gbps/32 Gbps links, providing a total of 64 Gbps/128 Gbps of bandwidth.

The UltraScale ICL capability provides dramatic reduction in the number of Inter-Switch Link (ISL) cables required—a four to one reduction compared to traditional ISLs with the same amount of interconnect bandwidth. And since the QSFP-based UltraScale ICL connections reside on the core routing blades instead of consuming traditional ports on the port blades, up to 33 percent more Fibre Channel ports are available for server and storage connectivity.

Given the many obvious advantages that the UltraScale ICL ports offer, a vast majority of large customers have built their fabrics with core-edge topology using Ultra Scale ICLs. A typical customer fabric based on Gen 5 Brocade DCX 8510 platforms today might look like the image in Figure 1.

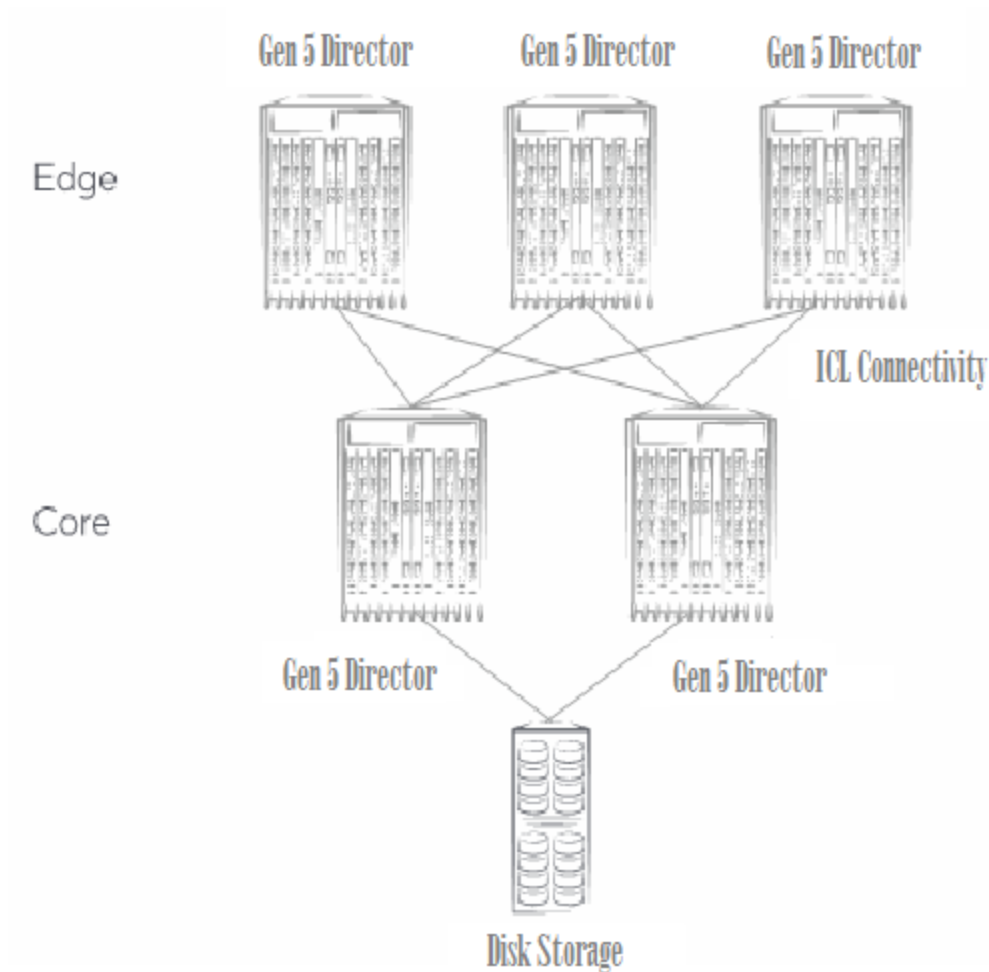


Figure 1: Existing Gen 5 Fabric.

For investment protection, the ThinkSystem Gen 6 family offers three generations of backward-compatibility support for connectivity to 4, 8, and 16 Gbps Fibre Channel (and FICON) products, allowing seamless connectivity between the older generation of devices and storage networking equipment. This enables an older storage infrastructure to continue to serve an organization's needs. An organization could also strategically plan to introduce Brocade X6 Directors into their

existing fabrics when new devices are added to their fabrics, whether due to new requirements or just ongoing growth. Two such cases are discussed below.

The first example is flash-based storage requirements. Flash technology is driving incredible advances in storage, dramatically reducing the historical Input/Output (I/O) performance gap between the server side (with multicore processors and faster memory) and the storage side (with drastically reduced access times). Flash-based storage addresses both IO and throughput bottlenecks, enabling faster block- and file-based storage performance for high-density virtualized workloads and traditional mission-critical applications.

When required to introduce or add more flash to existing fabric, new flash-based storage arrays (all-flash arrays or flash-optimized storage arrays) can be paired with a ThinkSystem Gen 6 Director and added to existing Gen 5 fabrics as shown in Figure 2. Although flash works with the Gen 5 technology, a number of benchmarks have demonstrated that a faster storage network can improve overall performance of flash-based storage. A few such studies have highlighted that Gen 6 provides the powerful combination that can be used today to accelerate applications, even with existing 8 Gbps and 16 Gbps storage arrays improving both database query times and latency by 50 percent^{1,2,3}. If large capital investments have already been made in flash-based storage, the storage network must be able to support the needed bandwidth and latency. Gen 6 is engineered to extract the best performance out of flash and thus offers the best Return on Investment (ROI) for an organization.

¹ Gen 6 Fibre Channel Evaluation of Products from Emulex and Brocade, <http://www.demartek.com/FC.html>.

² <http://www8.hp.com/h20195/v2/GetPDF.aspx/4AA5-8453ENW.pdf>.

³ The Performance and Efficiency of Gen 6 (32Gb) Fibre Channel, <http://www.qlogic.com/Search/Pages/Search.aspx?k=Gen%206%20fibre%20channel>

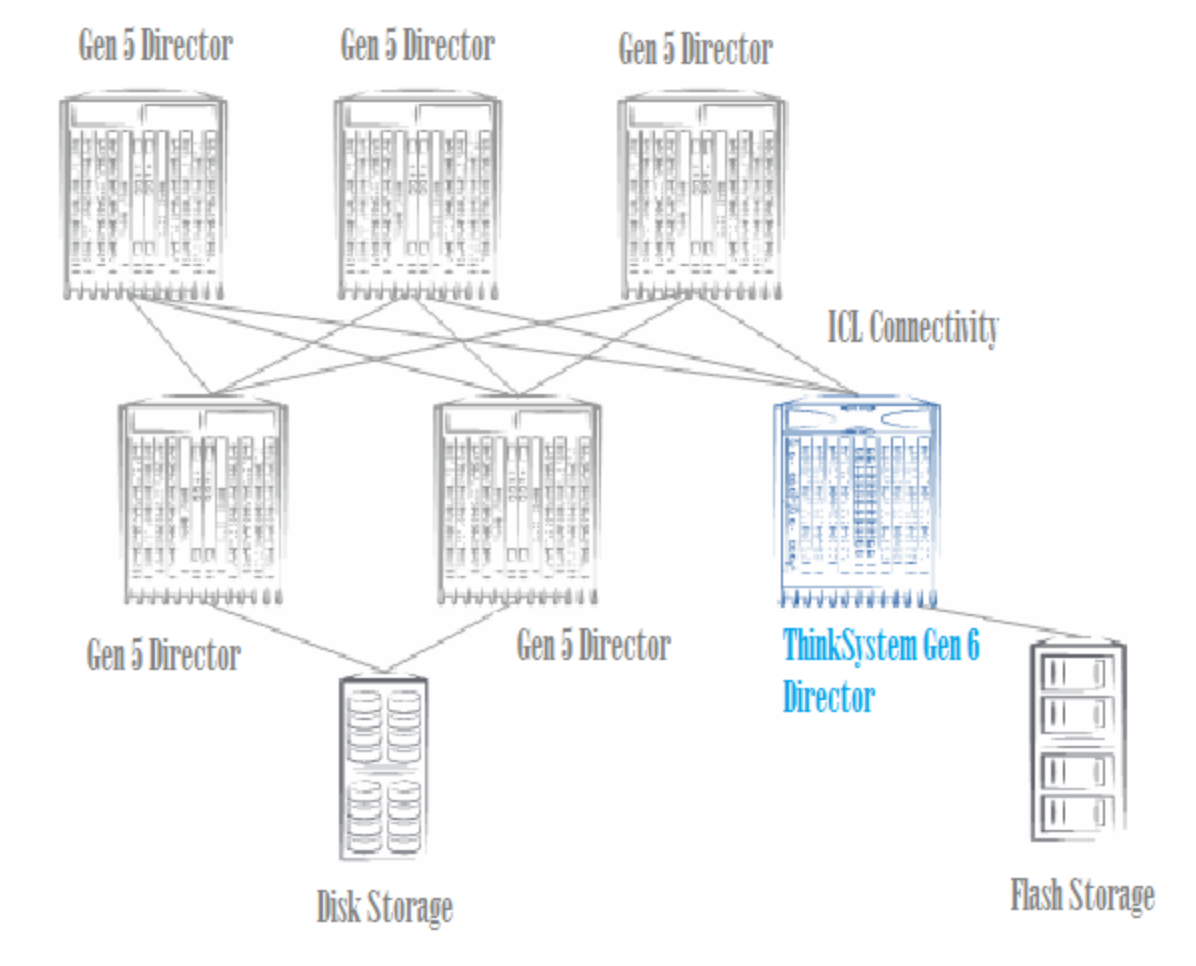


Figure 2: Adding ThinkSystem Directors and flash to an existing Gen 5 fabric

As a second example, highly virtualized infrastructures need high-performance storage networks. Evolving critical workloads and Tier 1 applications are being hosted on Virtual Machines (VMs). In addition to the increased use of server virtualization, VM densities (the number of VMs hosted on each physical server) are steadily increasing to 20, 40, or more VMs

per physical server—many of them booting from the SAN and accessing SAN resources. The increased usage, criticality, and density of VMs drive the demand for higher performance (bandwidth and IO), as well as increased reliability and availability from the storage infrastructure. In highly virtualized environments, any congestion, poor IO performance, or failures in the storage network impact a larger number of applications. Gen 6 Fibre Channel adds support for standards for the VM Insight (VMID) feature that enables VM-level fabric services and provides deeper integration of virtualized infrastructure with SAN storage fabric.

When the need arises to add more virtualized servers to an existing fabric, new servers can be paired with a ThinkSystem Gen 6 Director and a Gen 6 Host Bus Adapter (HBA) then added to an existing Gen 5 fabric, as highlighted in Figure 3. As is the case with flash-based storage, having a high-performance storage network to support the virtualized infrastructure is key. A recent paper by VMware concluded that by merely upgrading HBA and Fibre Channel storage network switches from 8 Gbps to 16 Gbps speeds, the vSphere 5.1 platform is able to support more storage devices and meet bandwidth requirements while using the same number of Fibre Channel links⁴. This paper also reports that larger block IOs have doubled their throughput together with better CPU efficiency per IO, benefiting applications like VMware vSphere Storage vMotion.

⁴ Gen 6 Fibre Storage I/O Performance on VMware vSphere 5.1 over 16 Gigabit Fibre Channel, <http://www.vmware.com/resources/techresources/10300>

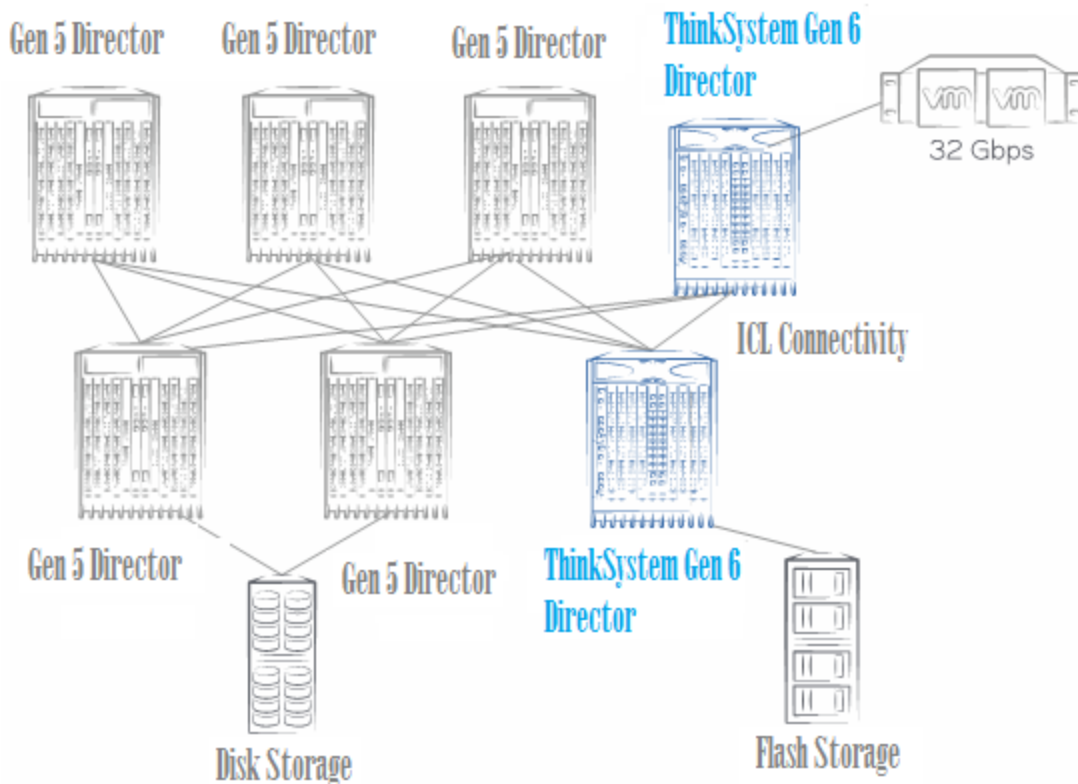


Figure 3: Adding more VM density with ThinkSystem Gen 6 directors to an existing Gen 5 Fabric

By thus pairing a highly virtualized infrastructure with Gen 6 HBAs and Gen 6 switches, application performance improves, resulting in a consolidated infrastructure while protecting existing and future investments in the storage infrastructure. Although the examples discussed in this paper illustrate core-edge fabrics, the same migration path can be achieved with full-mesh topologies. A ThinkSystem Gen 6 can connect to existing fabrics via traditional ISLs as well, and the same concepts apply if the existing fabric is using ISLs for interconnecting switches in the fabric.

Future-Proofing with the ThinkSystem Gen 6 Director Family

Further protecting future investments, the ThinkSystem Gen 6 Director family will support future Fibre Channel generations as a Gen 7-ready storage networking platform. The Lenovo backplane is designed with more links, to accommodate a doubling and quadrupling of bandwidth in the future. This will enable platform reusability for Gen 7 Fibre Channel, enabling organizations to maximize their Lenovo investments and optimize the performance of their networking infrastructures.

ThinkSystem Gen 6 platforms also enable customers to future-proof their storage networks by accelerating new technology deployments such as NVMe over Fabrics. NVMe is a new protocol for solid-state storage devices built with nonvolatile memory technologies. NVMe provides dramatically lower latency for storage IO operations and significantly higher IOPS per device. In the future, organizations will be able to transition their high-performance, latency-sensitive workloads to flash-based storage with NVMe over Fabrics, thus realizing significant performance gains and reaping the full benefits of flash.

NVMe over Fabrics will scale up the number of devices it can address by adopting NVMe over Fabrics technology. NVMe over Fabrics enables end users to achieve faster application response times from network-attached storage and to harness the performance of hundreds of solid-state drives for better scalability across virtual data centers. Fibre Channel is one of the fabric technologies that will be supported by NVMe over Fabrics. Lenovo Gen 5 and Gen 6 Fibre Channel switches already support NVMe over Fabrics, with no changes required. Customers can seamlessly integrate ThinkSystem Gen 6 Fibre Channel networks with next-generation NVMe over Fabrics without a disruptive rip and replace for the increased performance, application response time, and scalability that their next-generation data centers require.

Summary

The ThinkSystem Gen 6 Director family delivers long-term investment protection, enabling backward-compatibility to the existing infrastructure for some roughly 40 million Fibre Channel

ports already shipped, and to a Gen 7-ready storage networking infrastructure. The ThinkSystem Gen 6 also further future-proofs storage area networks by seamlessly integrating next-generation NVMe over Fabrics with current and future Gen 6 Fibre Channel networks.

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