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FAQ

Brocade® X6 Director
Frequently Asked Questions

Overview

Brocade provides the industry's leading family of Storage Area Network (SAN) switches and directors, including the Gen 6 Fibre Channel Brocade® X6 Director. This high-performance, highly reliable Fibre Channel director addresses a wide range of business requirements for the most demanding midsize to large enterprise data centers.

This document answers frequently asked questions about the Brocade X6 Director family.

For product information, visit www.broadcom.com/products/fibre-channel-networking/directors/x6-directors.

General Questions and Answers

What are Brocade X6 Directors?

Brocade X6 Directors are the industry's most reliable, scalable, and highest-performing storage networking infrastructure designed to meet demands for relentless growth and mission-critical applications. The Brocade X6 Director with Brocade Fabric Vision® technology combines innovative hardware, software, and integrated network sensors to ensure the industry's highest level of operational stability while redefining application performance. It provides both a modular building block for increased scalability to accommodate growth for large-scale enterprise infrastructures and the tools to optimize Non-Volatile Memory Express (NVMe) storage and automate SAN management tasks. The director's breakthrough 32 Gb/s performance accelerates application response time by up to 71% to eliminate I/O bottlenecks and unleash the full performance of flash and next-generation NVMe-based storage. And with diverse deployment options and multiprotocol flexibility, the Brocade X6 enables organizations to seamlessly adapt and optimize their businesses to meet next-generation storage requirements.

New automation capabilities enable DevOps to quickly automate and orchestrate storage network 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 implemented in a fraction of the time, while eliminating human error.

Integrated Fabric Vision technology enhances visibility into the health of the storage environment, providing administrators with greater control and insight to quickly identify problems and achieve critical service level agreements (SLAs). The Brocade X6 Director family, which includes the eight-slot Brocade X6-8 and four-slot Brocade X6-4, enables organizations to:

- Scale to 512 usable device ports with industry-leading port density and consolidate infrastructure via 128 Gb/s Brocade UltraScale ICL connectivity for simpler, flatter, low-latency fabrics
- Accelerate application response time by up to 71% across 32 Gb/s links
- Seamlessly integrate next-generation NVMe-attached storage without a disruptive rip-and-replace
- Optimize the performance of NVMe with IO Insight real-time latency monitoring
- Simplify end-to-end management and accelerate operations of large-scale environments, with Fibre Channel automation

- Provide proactive, real-time monitoring and alerts of storage I/O health and performance with integrated network sensors
- Enable Virtual Machine (VM) visibility in a storage fabric to monitor VM performance, identify VM anomalies, and optimize VM performance
- Design flexible architectures to increase agility with concurrent Fibre Channel, NVMe, FICON®, or FCoE connectivity
- Extend replication over distance with a highly scalable extension solution for Fibre Channel, IP replication, and FICON
- Mitigate risk with backward-compatibility while further protecting future investments with Gen 7-ready support

What is Brocade Gen 6 Fibre Channel?

Brocade Gen 6 Fibre Channel is the modern storage network infrastructure for high performance, mission-critical storage, delivering operational stability, breakthrough performance, and increased business agility to accelerate data access, adapt to evolving requirements, and drive always-on business operations. The Brocade X6 Director with Gen 6 Fibre Channel and Brocade Fabric Vision technology—which includes IO Insight and VM Insight—delivers unmatched 32 Gb/s performance, data center-proven availability, seamless scalability, and automated operations to ensure greater consistency, predictability, and performance while delivering operational efficiency.

What distinguishes Brocade X6 Directors from Brocade DCX® 8510 Backbones?

The Brocade X6 Director is the most advanced 32 Gb/s networking platform in the industry, enabling data-intensive, ultra-fast applications and unlocking the full capabilities of flash. With its modular chassis design, the Brocade X6 increases business agility with seamless NVMe storage connectivity and flexible multiprotocol deployment offerings.

The Brocade X6 Director is available in two modular form factors, 8-slot and 4-slot. Built for large enterprise networks, the 14U Brocade X6-8 has eight vertical slots for port blades that provide up to 512 32 Gb/s Fibre Channel device ports and 32 additional 128 Gb/s Brocade UltraScale ICL ports. The 8U Brocade X6-4, built for midsize networks, has four horizontal blade slots to provide up to 256 32 Gb/s Fibre Channel device ports and 16 additional 128 Gb/s UltraScale ICL ports. Each blade slot can be populated with three optional blades for local or remote connectivity.

For device connectivity, the Brocade FC32-48 Fibre Channel port blade provides 48 32 Gb/s Fibre Channel ports. For device and ISL connectivity, the Brocade FC32-64 Fibre Channel port blade provides 64 32 Gb/s ports in an elegant, high-density form factor. The Brocade FC32-64 is designed with QSFP-based Q-Flex connections that allow administrators to reduce their cabling infrastructure by 75%. In addition to providing high-density device connectivity, Q-Flex ports can be used to aggregate edge switches into a core with high-performance ISLs between the Brocade FC32-64 Port Blade in a Brocade X6 Director and Brocade G620 or G630 Switches. This allows organizations to effectively scale to meet data growth demands, handle more workloads, and drive efficiency by maximizing rack space.

The Brocade X6 Director increases flexibility with multiprotocol connectivity, allowing administrators to seamlessly adapt to next-gen requirements and design architectures with concurrent Fibre Channel, NVMe, or FCoE connectivity options. Organizations can seamlessly integrate Brocade Gen 6 Fibre Channel networks with next-generation NVMe without a disruptive rip-and-replace.

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. Using the Brocade FC32-64 Port Blade, the Brocade X6 Director provides FCoE host connectivity support by using the Q-Flex ports to design flexible architectures for increased agility.

To support disaster recovery and data protection storage solutions over long distances, the Brocade SX6 Extension Blade provides flexible Fibre Channel and IP storage replication deployment options with 16 32 Gb/s Fibre Channel ports, 16 1GbE/10GbE ports, and 2 40GbE ports. This blade allows organizations to seamlessly integrate extension capabilities within the Brocade X6 Director to provide extension services for large-scale, multi-site data center environments implementing block, file, and tape data protection solutions. The Brocade SX6 blade can be deployed with the Brocade 7840 Extension Switch in a data center-to-edge architecture as a cost-effective option for connecting primary data centers with remote data centers and offices. The Brocade X6 family supports 4, 8, 10, 16, and 32 Gb/s Fibre Channel; FICON; and 1, 10, 25, 40, and 100GbE on Ethernet-supported ports.

The Brocade X6 Director family provides investment protection through three generations of backward-compatibility support for connectivity to 4, 8, and 16 Gb/s Fibre Channel products. To further protect future investments, the Brocade X6 supports future Fibre Channel generations as a Gen 7-ready storage networking platform. In addition, the Brocade X6 Director allows for current Gen 6 and future generation switch blade modules to be added into the chassis.

The table below provides a detailed comparison of Brocade X6 Directors and Brocade DCX 8510 Backbones.

Feature	Brocade X6-8 Directors with Gen 6 Fibre Channel	Brocade DCX 8510-8 with Gen 5 Fibre Channel	Brocade X6-4 Directors with Gen 6 Fibre Channel	Brocade DCX 8510-4 with Gen 5 Fibre Channel
Total Bandwidth with Brocade UltraScale vs. Standard ICLs	20.5 Tb/s	8.2 Tb/s	8.1 Tb/s	4.1 Tb/s
Maximum Total Ports	512 at 32 Gb/s	512 at 16 Gb/s	256 at 32 Gb/s	256 at 16 Gb/s
Slot Bandwidth	1.5 Tb/s	512 Gb/s	1.5 Tb/s	512 Gb/s
Maximum Chassis Connected via UltraScale ICLs	12 core-edge 9 active-active mesh	12 core-edge 9 active-active mesh	6 core-edge 5 active-active mesh	6 core-edge 5 active-active mesh
UltraScale ICL Ports	32 at 128 Gb/s	32 at 64 Gb/s	16 at 128 Gb/s	16 at 64 Gb/s
UltraScale ICL Bandwidth	4.1 Tb/s	2 Tb/s	2 Tb/s	1 Tb/s
UltraScale ICL Cables	Up to 100m optical at 4×32 Gb/s speeds Up to 2 km at 32 Gb/s speeds	Up to 2 km at 16 Gb/s speeds	Up to 100 m optical at 32 Gb/s speeds Up to 2 km at 32 Gb/s speeds	Up to 2 km at 16 Gb/s speeds
Energy Efficiency	0.26 watts/Gb/s	0.30 watts/Gb/s	0.26 watts/Gb/s	0.30 watts/Gb/s
Automation Support	Yes[a]	Yes[a]	Yes[a]	Yes[a]
IO Insight and VM Insight	Yes (SCSI and NVMe[b])	N/A	Yes (SCSI and NVMe[b])	N/A
ClearLink Diagnostic Ports (D_Ports)	Yes	Yes	Yes	Yes
In-flight Compression	Yes	Yes	Yes	Yes
In-flight Encryption	Yes	Yes	Yes	Yes
10 Gb/s Native Fibre Channel	Included	Optional license	Included	Optional license
Forward Error Correction (FEC)	Yes (required)	Yes (optional)	Yes (required)	Yes (optional)
ASIC-Enabled Buffer Credit Loss Detection and Automatic Recovery at Virtual Channel Level	Yes	Yes	Yes	Yes

a. Requires running Brocade FOS 8.2 or higher.

b. IO Insight for NVMe traffic requires the Brocade FC32-64 Port Blade.

The Future of Fibre Channel Technology

Is Fibre Channel still the best infrastructure for data center storage?

Yes. Fibre Channel remains the de facto standard in networking infrastructure for mission-critical storage in the data center. Digital transformation is pushing mission-critical storage environments to the limit, with users expecting data to be accessible from anywhere, at any time, on any device. Faced with exponential data growth and the pressure to deliver maximum performance, business intelligence, and operational efficiency, the network must evolve to enable businesses to thrive in this new era. To meet these dynamic and growing business demands, organizations need to deploy infrastructure that can deliver greater consistency, predictability, and performance. Legacy infrastructure, however, was not designed to support the performance requirements of evolving workloads and flash-based storage technology. By modernizing the storage network with Gen 6 Fibre Channel, organizations are able to maximize productivity and increase the efficiency of their storage investments, even as they rapidly scale their environments. 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. With the Brocade X6 Director, organizations can seamlessly transition to an all-flash data center and build a foundation to support future innovation and operational efficiency.

Does the Brocade X6 Director seamlessly support NVMe (Non-Volatile Memory Express)?

To realize the full benefits of flash, organizations must transition their high-performance, latency-sensitive workloads to flash-based storage with NVMe over Fibre Channel. The simplicity and efficiency of NVMe enable significant performance gains for flash storage. NVMe allows 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.

Organizations can seamlessly integrate Brocade Gen 6 Fibre Channel networks with next-generation NVMe without a disruptive rip-and-replace. 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. With the Brocade FC32-64 Port Blade, the Brocade X6 Director can optimize performance with enhanced IO Insight monitoring for NVMe over Fibre Channel with integrated, non-intrusive, real-time monitoring and alerts for network performance. This proactive monitoring of NVMe over Fibre Channel traffic and VMs provides deep diagnostics and visibility to maintain optimal network health and performance.

What value does 32 Gb/s port speed provide when I currently have sufficient bandwidth at 8/16 Gb/s?

Legacy infrastructure was not designed to support today's dynamic and growing business demands and requirements for evolving workloads and flash-based storage technology. An aging network impedes the performance of an all-flash data center. Gen 6 Fibre Channel solutions with unmatched 32/128 Gb/s performance are ideally designed to enable these applications and unlock the full capabilities of flash. However, the true value of Gen 6 Fibre Channel extends beyond performance and higher throughput. Higher reliability and innovative integrated technologies—such as IO Insight, VM Insight, Brocade UltraScale ICL (Inter-Chassis Link) connectivity, and Fabric Vision technology—dramatically simplify end-to-end management of large-scale environments and drive down operational costs.

Gen 6 Fibre Channel with Fabric Vision technology delivers powerful monitoring, management, and diagnostic tools to improve operational stability and dramatically reduce costs. Gen 6 Fabric Vision technology includes IO Insight, which provides organizations with deeper visibility into the performance of their environments. This enhanced visibility enables organizations to easily identify degraded application performance at the host and storage tiers. As a result, administrators can quickly identify issues, avoid problems, and meet SLA objectives.

Feature	Gen 5 Fibre Channel	Gen 6 Fibre Channel
Flow-level monitoring for storage SLAs	Frame level	Device and application level
Automatically detect degraded application performance with IO Insight through integrated network sensors	Not available	Available
Visibility and metrics to tune device performance	Not available	Available
Gen 7-ready storage networking infrastructure	Not available	Available
Non-oversubscribed backplane for 48 line-rate ports	Available with local switching (32 line-rate ports without local switching	Available
VM or device connectivity scale	Accommodates high-density VM deployments	2× scale capability of Gen 5 VM deployments
Deployment flexibility: Dual direction airflow	Not available	Available
Higher supportability, RAS features	Available	Enhanced
IP and Fibre Channel extension for flexible storage DR/BC requirements	Appliance-based	Modular platform-integrated
In-flight compression	Supported	3× the Gen 5 bandwidth
Encryption	Supported	2× the Gen 5 bandwidth
Forward Error Correction (FEC)	Available	More robust and flexible
Maximum port speed	Up to 16 Gb/s	Up to 32 Gb/s
More buffers per switching ASIC	8K	15K

What value do Brocade UltraScale Inter-Chassis Links (ICLs) provide for the Brocade X6?

Both Gen 5 backbones and Gen 6 directors provide up to 32 QSFP ports on the 8-slot chassis and up to 16 QSFP ports on the 4-slot chassis to preserve switch ports for end device connections. Each QSFP port has four independent 16/32 Gb/s links, providing a total of 64/128 Gb/s of bandwidth. Gen 6 UltraScale ICL technology provides a high-density solution that doubles the bandwidth with 128 Gb/s connectivity to enable flatter, faster, and simpler fabrics that increase consolidation while reducing network complexity and costs.

The Gen 6 UltraScale ICL connectivity ports support standard optical cables up to 100 meters at Gen 6 (4×32 Gb/s) speed and 2 km at Gen 5 (4×16 Gb/s) speed for longer distances. Gen 6 UltraScale ICLs are backward-compatible and can connect to Gen 5 ICL ports, enabling organizations to maximize their investments. UltraScale ICLs enable connections of up to 12 chassis in a core edge, and up to nine chassis in an active-active mesh topology. These high-density chassis topologies reduce inter-switch cabling by 75% and free up to 33% of ports for servers and storage. This maximizes overall port density within the smallest amount of rack space while freeing up front-facing device ports for server and storage connectivity.

What UltraScale Inter-Chassis Link (ICL) kits are required to enable these ports on the Brocade X6?

The Brocade X6 Director requires two ICL kits to enable the full capacity of chassis. To license all ports on the Brocade X6-8, two Brocade X6-8 ICL kits are required; to license all ports on the Brocade X6-4, two Brocade X6-4 ICL kits are required. These ICL kits can provide connectivity for Gen 6 to Gen 6, or Gen 6 to Gen 5.

Kit	Number of Optics in the Kit	Licensed Ports	Purpose
Brocade X6-8 ICL Kit 100m P/N: BR-X68ICLKIT-100M-02	16	16 QSFP ports per chassis (8 QSFP ports per CR blade)	Gen 6 to Gen 6 at 4×32 Gb/s for up to 100m or Gen 6 to Gen 5 at 4×16 Gb/s for up to 100m
Brocade X6-8 Gen 6 ICL Kit 2 km	8	16 QSFP ports per chassis (8 QSFP ports per CR blade)	Gen 6 to Gen 6 at 4×32 Gb/s for up to 2 km
Brocade X6-4 ICL Kit 100m P/N: BR-X64ICLKIT-100M-02	8	8 QSFP ports per chassis (4 QSFP ports per CR blade)	Gen 6 to Gen 6 at 4×32 Gb/s for up to 100m or Gen 6 to Gen 5 at 4×16 Gb/s for up to 100m
Brocade X6-4 Gen 6 ICL Kit 2 km	8	8 QSFP ports per chassis (4 QSFP ports per CR blade)	Gen 6 to Gen 6 at 4×32 Gb/s for up to 2 km

What is the Throughput of the UltraScale ICL Connections? What Happens if an UltraScale ICL Connection Fails?

Each UltraScale ICL port provides 128 Gb/s of bandwidth over a QSFP (4×32 Gb/s) link. A minimum of four ports (two from each core switching blade) is required to connect chassis together. The Brocade X6-8 has a total of 32 UltraScale ICL ports (16 per Brocade CR16-8 core switching blade) that deliver 4.1 Tb/s of bandwidth. This is equivalent to 128 32 Gb/s ISLs. The Brocade X6-4 has a total of 16 UltraScale ICL ports (eight per Brocade CR16-4 core switching blade) that deliver 2 Tb/s of bandwidth. This is equivalent to 64 32 Gb/s ISLs. Frame-based trunking is enabled between up to four UltraScale ICLs. Brocade Dynamic Path Selection (DPS) balances exchanges across all ICL connections using a hash of the SID, DID, RxPort, and OxID. If an UltraScale ICL connection fails, all traffic travels over remaining active links.

Can UltraScale ICLs and ISLs be used together to connect chassis?

Simultaneous ICL and ISL connectivity between two Brocade X6 chassis is not supported. However, if Brocade Virtual Fabrics is enabled, simultaneous ICLs and ISLs can coexist between a pair of Brocade X6 and/or Brocade DCX 8510 chassis if ICLs are in a different logical switch than the ISLs.

What types of cables are used with the 4×32 GFC 100m QSFP+ for UltraScale ICLs?

Brocade X6 UltraScale ICL cables connect UltraScale ICL ports over OM3 or OM4 optical cables in the following manner:

- Brocade X6 4×32 GFC 100m QSFPs require MPO 1×12 OM4 ribbon cable connectors and multimode ribbon fiber cable, limited to 100 meters.
- Although the connector has 12 lanes in a row, the 4×32 GFC QSFP uses only the outer eight lanes (four from each end). The central four lanes are not used.
- Plug orientation does not matter because the plug is polarized—it takes care of itself, just like RJ-45. Specifically, it is female-female and key-up to key-up orientation.

Cables are available from:

Vendor	1m (OM3 part number)	10m (OM3 part number)	50m (OM3 part number)	50m (OM4 part number)	100m (OM4 part number)
Molex	106283-1005	106283-1015	106283-1050	N/A	N/A
Wave2Wave	50-4120P-1M	50-4120P-10M	50-4120P-50M	50-9120P-50M	50-9120P-100M
CWI Trading	N/A	N/A	N/A	QSFP-PFPF-4R-50M	QSFP-PFPF-4R-100M

What types of QSFPs are used with the new 4×32 GFC 100m QSFP+ for UltraScale ICLs?

Brocade-branded 4×32 Gb/s (100m and 2 km) and 4×16 Gb/s (100m and 2 km) are supported. The Brocade 4×32 Gb/s QSFPs support interoperability with Gen 5 4×16 Gb/s QSFPs for up to 100m. This new QSFP is offered as an ICL kit (BRX68ICLKIT-100M-02/BR-X64ICLKIT-100M-02) and as a FRU (XBR-000275). The 4×16 Gb/s 2 km QSFPs are required on the Brocade X6 for connectivity to Brocade DCX 8510 ICL ports for distances greater than 100m, up to a maximum of 2 km.

What are Q-Flex ports on the Brocade FC32-64 Port Blade?

Q-Flex ports provide flexible device and ISL connectivity with industry-leading 32 Gb/s QSFP optics. These ports are designed to connect to a single QSFP or fan out to four standard SFP+ connections, enabling administrators to simplify cabling infrastructure. With the Brocade FC32-64 Port Blade, all Q-Flex ports are enabled. QSFP modules increase port density four times more than SFP+ modules and reduce the number of cables per blade from 64 to 16, significantly reducing cable management challenges.

Brocade FC32-64 Port Blade Q-Flex ports support 4×32 Gb/s, 4×16 Gb/s, 4×10GbE, and 4×25GbE QSFPs, and provide greater flexibility with breakout cable support.

QSFPs can be ordered with the following part numbers:

- 4×32 Gb/s 2km QSFP: XBR-000285 (supported with Brocade FOS 8.2 or later)
- 4×32 Gb/s QSFP: XBR-000275
- 4×16 Gb/s QSFP: XBR-000245
- 4×10GbE QSFP: XBR-40G-SR4-INT-0286
- 4×10GbE QSFP: XBR-40G-SR-BIDI-0287
- 4×25GbE QSFP: XBR-100G-SR4-0288

What Fibre Channel speeds are supported on Brocade Q-Flex ports?

The Q-Flex ports are capable of 4×32 Gb/s, 4×16 Gb/s, 4×8 Gb/s, and 4×4 Gb/s Fibre Channel speeds as well as 4×10GbE and 4×25GbE Ethernet speeds. Check the hardware manual and the Brocade FOS Administrative Guide for support information.

Can Q-Flex ports on the Brocade FC32-64 Port Blade be connected to Q-Flex ports on the Brocade G620 and G630 Switches?

Q-Flex ports can be used to aggregate edge switches into a core to form a high-density fabric with high-performance ISLs between the Brocade FC32-64 Port Blade in a Brocade X6 Director and Brocade G620 or G630 Switches.

Can Q-Flex ports be connected to ICL ports on the Brocade X6 or Brocade DCX 8510 Directors?

No. This capability is not supported.

Do Q-Flex ports support splitter cables and patch panels?

Each Q-Flex port is capable of supporting 128 Gb/s parallel Fibre Channel for device or ISL connectivity with MTP/MPO cables, MTP/MPO to LC breakout cables, and patch panels. This design supports a large number of device ports with simplified cable connectivity and enables Gen 6 solutions to integrate seamlessly into a structured cabling infrastructure.

What is the Ethernet capability of Q-Flex ports on the Brocade FC32-64?

The Brocade FC32-64 functions as a Fibre Channel Forwarding (FCF) switch that terminates Fibre Channel over Ethernet (FCoE) frames.

Can Q-Flex ports be aggregated together when in Ethernet mode?

Yes. Q-Flex ports can act either independently or be aggregated together to create a Link Aggregation Group (LAG). The LAG capability is compliant to industry standards.

What is the primary usage of Ethernet protocol on Q-Flex ports on the Brocade FC32-64?

These ports provide connectivity for Data Center Bridge (DCB)-enabled host servers and switch ports carrying FCoE storage-bound traffic. This functionality has been tested to operate with Cisco UCS 6200 and 6300 Series Fabric Interconnects.

What is integrated metro and geo connectivity?

Brocade X6 Directors also support integrated storage extension over native Fibre Channel (metro connections up to 100 km) or over Fibre Channel over IP (FCIP) (geo connections beyond 100 km) on all ports. Native Fibre Channel connections now include in-flight encryption and compression as well as optional support for 10 Gb/s Fibre Channel over DWDM and dark fiber. With the Brocade SX6 Extension Blade, the Brocade X6 Director provides integrated metro and global connectivity with a purpose-built data center extension solution for Fibre Channel and IP storage environments. This solution delivers unprecedented performance, strong security, continuous availability, and simplified management to handle the unrelenting transfer of data between data centers and to maintain SLAs.

The Brocade X6 Director can scale up to four Brocade SX6 blades per chassis. Each Brocade SX6 Extension Blade provides 16 32 Gb/s Fibre Channel/FICON ports, 16 1/10-Gigabit Ethernet (GbE) ports, and 2 40GbE ports to deliver the high bandwidth, port density, and throughput required for maximum application performance over WAN connections, and to address the most demanding disaster recovery requirements.

What are the benefits of in-flight compression over ISLs?

In-flight compression optimizes network performance within the data center and over long-distance links. Data is compressed at the source and uncompressed at the destination. Performance varies by data type, but Brocade uses an efficient algorithm to generally achieve 2:1 compression with minimal impact on performance. In-flight compression is only available on Gen 6 Fibre Channel port blades.

What are the benefits of in-flight encryption over ISLs?

In-flight encryption minimizes the risk of unauthorized access for traffic within the data center and over long-distance links. It is switch-to-switch encryption, not device or data-at-rest encryption. Data is encrypted at the source and decrypted at the destination. Encryption and decryption are performed in hardware using the AES-GCM-256 algorithm, minimizing any impact on performance. Encryption can be used in conjunction with in-flight compression. In-flight encryption is available only on the Gen 6 Fibre Channel Brocade FC32-48 and FC32-64 Port Blades for the Brocade X6, and is complementary with in-flight IP encryption provided by the Brocade SX6 Extension Blade.

How does the Gen 6 ASIC compare to previous generations?

The Gen 6 ASIC is the industry's most powerful and efficient Fibre Channel switching technology. In addition to Gen 6 Fibre Channel 32 Gb/s speed and 128 Gb/s speed, it includes more bandwidth (2 Tb/s), faster I/O performance (566 million frames switched per second), 33% more density (allowing the Brocade X6 to gain three times more slot bandwidth than Gen 5), and more functionality that includes Fabric Vision, IO Insight, Brocade ClearLink® Diagnostics, in-flight encryption and compression, and Forward Error Correction (FEC).

What power management features are included?

Brocade X6 port blades and Brocade Gen 6 Fibre Channel switches support real-time power measurement, providing insight into power consumption in the fabric.

Brocade X6 Director Hardware

What 8 Gb/s or 16 Gb/s Brocade DCX and DCX 8510 blades are compatible with Brocade X6 chassis?

The Brocade X6 does not support any of the existing 8 Gb/s or 16 Gb/s blades; however, the Gen 6 Brocade FC32-48 and FC32-64 blades do support 4, 8, and 16 Gb/s connectivity.

Can Brocade FC16-32, FC16-48, and FC16-64 16 Gb/s blades be upgraded to 32 Gb/s blades?

No. Brocade FC16-32, FC16-48, and FC16-64 blades are not upgradable to 32 Gb/s functionality.

What Blades are Available for the Brocade X6 Directors and Brocade DCX 8510 Backbones?

The following table lists the blades supported by each:

Brocade Blade	Brocade X6-8	Brocade X6-4	Brocade DCX 8510-8	Brocade DCX 8510-4
FC32-64	✓	✓	N/A	N/A
FC32-48	✓	✓	N/A	N/A
FC16-32	N/A	N/A	✓	✓
FC16-48	N/A	N/A	✓	✓
FC16-64	N/A	N/A	✓	✓
FC8-32E	N/A	N/A	✓	✓
FC8-48E	N/A	N/A	✓	✓
FC8-64	N/A	N/A	✓	✓
SX6	✓	✓	N/A	N/A
FCOE10-24	N/A	N/A	✓	N/A
FX8-24	N/A	N/A	✓	✓
Brocade DCX 8510 Control Processor	N/A	N/A	✓	✓
Brocade X6 Control Processor	✓	✓	N/A	N/A
Core Switching	Brocade CRX-8	Brocade CRX-4	Brocade CR16-8	Brocade CR16-4

How many Brocade SX6 Extension Blades can be utilized per Brocade X6 chassis?

Up to four Brocade SX6 blades per chassis are currently supported.

How is chassis bandwidth calculated for Brocade X6 Directors?

With all 512 (Brocade X6-8) or 256 (Brocade X6-4) ports running at full 32 Gb/s speed (data rate) and with all traffic traveling over the backplane (utilizing slot bandwidth), there is no oversubscription with the Brocade FC32-48 Port Blade and 1.33:1 oversubscription performance for the Brocade FC32-64 Port Blade. Brocade X6 Directors also support local switching—with ingress/egress traffic on the same blade—which yields no oversubscription as well.

ICL bandwidth adds an additional 4.1 Tb/s (Brocade X6-8) and 2.1 Tb/s (Brocade X6-4). The combination of port and ICL bandwidth yields the total chassis bandwidth of 16.2 Tb/s (Brocade X6-8) or 8.1 Tb/s (Brocade X6-4).

Are Brocade Small Form-Factor Pluggable plus (SFP+) optics required for the Gen 6 Fibre Channel Brocade X6 Director?

Yes. Brocade X6 Directors require Brocade-branded SFP+ optics.

Why do Brocade X6 Directors require Brocade SFP+ optics?

Brocade SFP+ optics have advanced features, such as Brocade ClearLink Diagnostics, that help ensure optical and signal integrity for Gen 5 and Gen 6 Fibre Channel optics and cables, simplifying the deployment and support of high-performance fabrics. In addition, using Brocade optics provides quality control that in turn avoids application downtime. The greater the port speed—especially 32 Gb/s—the less tolerance that directors and switches have for out-of-spec wavelengths that lead to port failure and application interruption.

Are supported cable distances affected by 32 Gb/s?

Yes. Supported distances are reduced as Fibre Channel speed increases. See the table below.

Transceiver Type	**Form Factor**	**Speed**	**Multimode Maximum Distance**				**Single-Mode Maximum Distance**
—	—	—	OM1	OM2	OM3	OM4	9 µm
SWL	SFP+	32 Gb/s	—	—	70m	100m	Not applicable
		16 Gb/s	15m	35m	100m	125m	
		10 Gb/s	33m	82m	300m	550m	
		8 Gb/s	21m	50m	150m	190m	
LWL	SFP+	32 Gb/s	Not applicable				10 km
		16 Gb/s					10 km
		10 Gb/s					10 km
		8 Gb/s					10 km
ELWL	SFP+	32 Gb/s	Not applicable				10 km
		16 Gb/s					10 km, 25 km
		8 Gb/s					25 km

What cable management solutions are available for Brocade X6 Directors?

Brocade X6 Directors include horizontal (Brocade X6-8) and vertical (Brocade X6-4) cable combs for basic cable management. Brocade cable management and patch panel partners offer structured cable management solutions using patch panels for existing (1U LC patch panel) and high-density (1U MPO patch panel) solutions.

Which components are common between the Brocade X6-8 and Brocade X6-4 models? Which are different?

Both the Brocade X6-8 and Brocade X6-4 models utilize the same Gen 6 Fibre Channel SFP+ (32 Gb/s and 128 Gb/s SFP+), Brocade FC32-48 (32 Gb/s 48-port) port blade, Brocade FC32-64 (32 Gb/s 64-port) port blade, and Brocade SX6 Extension Blade (for FCIP). They also use the same Control Processor (CPX) blade, power supply, fan, WWN cards, and Brocade UltraScale ICL cables and optics. Besides the chassis, the only components that differ between the Brocade X6-8 and Brocade X6-4 models are the core switching blades (Brocade CR32-8 and CR32-4).

Does Brocade X6 Directors work with existing firmware versions in current fabrics?

Brocade X6 models require Brocade FOS 8.0.1 or greater. Brocade X6 models are compatible with all 8 Gb/s platforms running Brocade FOS 7.3.1 or later connectivity. Any 4 Gb/s legacy devices running prior versions of Brocade FOS are supported only through Fibre Channel routing. For complete support information, refer to the respective Brocade FOS release notes.

The Brocade X6-8 model accommodates four power supplies. Why does it ship with three? Do both the Brocade X6-8 and Brocade X6-4 support 240 VAC and 110 VAC power supplies?

Three 240 VAC power supplies come standard with the Brocade X6-8 model for a 2+1 configuration for redundancy. All are active, but if one fails, the others provide enough power to maintain the entire chassis. Four total power bays are available for higher (power) availability, and four must be installed to provide the greatest power efficiency and a 2+2 redundant configuration. The Brocade X6-8 also supports using 110 VAC power input (on the same power supply units) in place of the 240 VAC power input. The Brocade X6-4 has two power supply bays and ships fully populated. Both are active/active, but if one fails, the other provides power for the entire chassis. The 110 VAC power input can also be used to provide power, but with some restrictions. Refer to the Brocade X6 Director hardware installation guide for additional information.

Do Brocade X6 Directors support High Voltage AC (HVAC) or High Voltage DC (HVDC) power supplies?

Yes. Starting with Brocade Fabric OS (FOS) v8.1.0, Brocade X6 Directors support HVAC and HVDC input via a new Power Supply Unit (PSU). Both HVAC and HVDC inputs are supported via this single new PSU. This HV PSU is rated as follows:

Type	Related Input Voltage	Operating Input Voltage Range (Nominal)
High Voltage DC (HVDC)	240 VDC to 380 VDC	192 VDC to 400 VDC
High Voltage AC (HVAC)	100 VAC to 120 VAC 200 VAC to 277 VAC	90 VAC to 277 VAC

Refer to the Brocade X6 Director hardware installation guide for additional information.

Does Brocade offer/support upgrades to HV PSUs on an existing Brocade X6 chassis (already shipped with 240 VAC PSUs)?

No. Due to regulatory requirements, upgrading existing Brocade X6 Director chassis to include HVAC/HVDC PSUs in the install base is not supported.

Are there new base chassis SKUs that bundle HV power supplies?

No. However, HV power supplies can be added to a build-to-order base chassis. This build-to-order base chassis does not include fans or power supplies. After selecting a build-to-order chassis, you may add fans and the type of PSU (regular or HV), depending on the configuration and airflow required.

What types of power cords are supported with HV power supplies?

Brocade offers two power cords for HV power supplies based on compliance and regional requirements:

- PC-UNIVERSAL-LUGS-SAFD: For the OT-M6 port (LUGS) on the terminal side. This power cord is IEC57/CCC-compliant and rated at 400V 75°C. It is supported in China.
- PC-UNIVERSAL-SAFD: Provides unterminated wires on the terminal side and hence provides flexibility in deployment, as termination connectors and connectivity would vary based on the application (AC, DC) and country plug type. This power cord is ULand TUV-compliant and rated at 14 AWG 600V and up to 90°C. It is supported in all other regions outside of China.

Are the 240 VAC power cords (that are currently available) supported with HV power supplies?

No, 240 VAC power cords are not compatible with HV power supplies. This is due to a SAF-D type connector on the PSU, which is different than the C19 connector that exists on 240 VAC power supplies.

Brocade X6 Software

What advance software is bundled with the Brocade X6-8 and X6-4?

The Brocade X6-8 and X6-4 models both ship standard with the Enterprise bundle, which includes Brocade Fabric Vision technology, Brocade Extended Fabric, Brocade Trunking, and CUP.

What optional software licenses are available for Brocade X6 Directors?

Two optional value-add licenses are available: Integrated Routing Ports on Demand and ICL Ports on Demand (PoD). The Integrated Routing Ports on Demand license provides a maximum of 128 Fibre Channel ports with Integrated Routing capability. The ICL PoD license, offered together with optics as part of the ICL kits, enables the UltraScale ICL ports on Brocade X6 Directors. All other value-add software is included within the Brocade X6 Director, including integrated 10 Gb/s Fibre Channel extension and the Enterprise ICL license.

What is Brocade Fabric Vision technology?

Brocade Fabric Vision technology is an advanced hardware and software solution that combines capabilities from the Brocade Fibre Channel ASIC, Brocade Fabric OS® (FOS), and Brocade SAN management to help administrators address problems before they impact operations, accelerate new application deployments, and dramatically reduce operational costs. Fabric Vision technology provides unprecedented visibility and insight across the storage network through innovative diagnostic, monitoring, and management technology.

For additional information about Fabric Vision technology, visit www.broadcom.com/products/fibre-channel-networking/software/storage-fabrics-technology.

What are the advantages of Brocade Fabric Vision technology?

Brocade Fabric Vision technology provides a breakthrough hardware and software solution that helps simplify monitoring, maximize network availability, and dramatically reduce costs. Featuring innovative monitoring, management, and diagnostic capabilities, Fabric Vision technology enables administrators to avoid problems before they impact operations, helping their organizations meet SLAs.

For additional information about Fabric Vision technology, visit www.broadcom.com/products/fibre-channel-networking/software/storage-fabrics-technology.

What Fabric Vision technology capabilities are supported in Brocade 8 Gb/s, Gen 5, and Gen 6 platforms?

Some Fabric Vision technology features are supported on Brocade 8 Gb/s platforms; others are available only on Brocade Gen 5 Fibre Channel platforms. The chart below shows the various Fabric Vision technology features supported on each generation of products.

Features	8 Gb/s Platforms	Gen 5 Platforms	Gen 6 Platforms
Forward Error Correction (FEC)	No	Yes	Yes
VC-level BB_Credit Recovery	No	Yes	Yes
Brocade ClearLink Diagnostics (D_Port)	No	Yes	Yes
MAPS	Yes	Yes	Yes
Fabric Performance Impact (FPI) Monitoring	Yes	Yes	Yes
Flow Learning	No	Yes	Yes
Flow Monitor	Yes, with some limitations	Yes	Yes
Flow Mirroring	No	Yes	Yes
Flow Generator	No	Yes	Yes
COMPASS	Yes	Yes	Yes
IO Insight	No	No	Yes
IO Insight for NVMe	No	No	Yes, only on the Brocade G630 and the Brocade X6 with the Brocade FC32-64 Port Blade
VM Insight	No	No	Yes

What is IO Insight?

IO Insight is integrated within the Brocade G620 Switch, Brocade G630 Switch and Brocade X6 Directors. It helps organizations achieve greater control and insight to quickly identify the root cause of problems at the storage tier, reducing time to resolution so critical SLAs can be met. The IO Insight capability non-intrusively gathers I/O statistics, which can be used within an intuitive, policy-based monitoring and alerting suite to configure thresholds and alarms. In-band device latency and IOPS monitoring detects degraded storage performance, allowing administrators to proactively optimize performance and availability to ensure maximum performance. Additional features include:

- Provides proactive, non-intrusive, real-time monitoring and alerting with visibility into storage I/O health and performance
- Monitors individual host or storage devices to gain deeper insights into the performance of the network in order to maintain SLA compliance
- Obtains I/O latency and IOPS metrics for a storage device in order to diagnose I/O operational issues

How can IO Insight metrics be monitored?

The Flow Vision feature provides the IO Insight metrics on Gen 6 switch device ports for a specific initiator-target or initiator-target volume flow. These metrics can be gathered on both SCSI and NVMe over Fibre Channel protocols. Administrators can import the flow into MAPS to configure thresholds on I/O latency metrics and receive alerts when those thresholds are exceeded.

How do IO Insight features differ among switch models?

The table below illustrates the IO Insight features available with different Brocade switches and directors.

Feature	Brocade G610	Brocade G620	Brocade G630	Brocade X6 Directors
IO Insight support	N/A	Yes	Yes	Yes
NVMe statistics	N/A	No	Yes	Yes, with the Brocade FC32-64 Port Blade No, with the Brocade FC32-48 Port Blade
initiator-target	N/A	Yes	Yes	Yes
initiator-target-volume flow	N/A	No	No	Yes
Metrics available at storage ports	N/A	Yes	Yes	Yes
Metrics available at host ports	N/A	No	No	Yes

What are the differences between IO Insight and Brocade Analytics Monitoring Platform?

The table below shows the different features and capabilities of these technologies.

Fabric Vision with IO Insight	Brocade Analytics Monitoring Platform
SCSI Read/Write response/latency monitoring	Full visibility into all SCSI commands
Statically defined initiator-target or initiator-target-volume flow	Automatic flow learning, including LUN learning
Alerts for host and storage outliers	Alerts for host, fabric, and storage outliers/individual I/O
Identifies latency and congestion	Identifies latency and congestion, and provides direct fabric latency monitoring
Monitors only Gen 6 Fibre Channel	Monitors both Gen 5 and Gen 6 Fibre Channel
Storage I/O-level monitoring	Large-scale, end-to-end I/O monitoring

What is VM Insight?

VM Insight uses standards-based, end-to-end VM tagging to gain VM visibility in a storage fabric. VM Insight enables the monitoring of VM-level application performance and baseline workload behavior. Using this information, storage administrators can quickly determine whether a storage fabric is the source of performance anomalies for VM-level applications. VM Insight also enables fast correlation with other Fabric Vision metrics to identify the root cause of problems before operations are affected. VM Insight provides the visibility for administrators to provision and plan storage networks based on application requirements, and to fine-tune the infrastructure to meet service-level objectives.

What is Brocade ClearLink Diagnostics?

The Brocade ClearLink Diagnostics tool leverages Brocade ClearLink Diagnostic Port (D_Port) mode to ensure optical and signal integrity for Fibre Channel optics and cables, simplifying deployment and support of high-performance fabrics. By proactively verifying the integrity of critical transceivers, organizations can quickly address any physical layer issues without the need for special optical testers.

ClearLink Diagnostics allows users to automate a battery of tests to measure and validate latency and distance across the switch links, as well as to verify the integrity of the fiber and optical transceivers in the fabric—prior to deployment or when there are suspected physical layer issues. With ClearLink Diagnostics, only the ports attached to the link being tested need to go offline, leaving the rest of the ports to operate online.

In addition to switch-to-switch link validation, ClearLink Diagnostics also provides the following:

- Dynamic ClearLink Diagnostics support between Gen 5 and Gen 6 Fibre Channel switches, QLogic, and Emulex® fabric adapters when running at 16 Gb/s or 32 Gb/s, allowing administrators to initiate tests from the adapter.
- The ability to configure settings to ensure consistency and automatically run D_Port tests based on port or switch events, including links over xWDM.
- D_Port pre-provisioning to improve operational control and avoid costly mistakes.
- D_Port integration into MAPS for threshold-based monitoring and alerting.
- Port LED for a visual indication of D_Port test result failures.
- Link power (dB) loss information with D_Port test results.
- Through collaboration with industry partners, Brocade extends ClearLink Diagnostics to additional end devices and adapters, providing end-to-end physical layer diagnostics and validation.

What SAN management software is supported on Brocade X6 Directors?

Brocade SANnav Management Portal, Brocade SANnav Global View, and Brocade Network Advisor are supported on Brocade X6 Directors. However, to run SANnav Management Portal, the directors must run Brocade FOS 7.4 or above.

For more information on SANnav Management Portal, visit www.broadcom.com/sannav.

Is a trial license available for both Brocade SANnav Management Portal and SANnav Global View?

Yes. 90-day trial versions of SANnav Management Portal and SANnav Global View are available for download. These trial versions provide full functionality and can support up to 15,000 instances and ports. For additional information, refer to the Brocade SANnav Management Portal and SANnav Global View FAQ at www.mybrocade.com.

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