Brocade® X7 Director
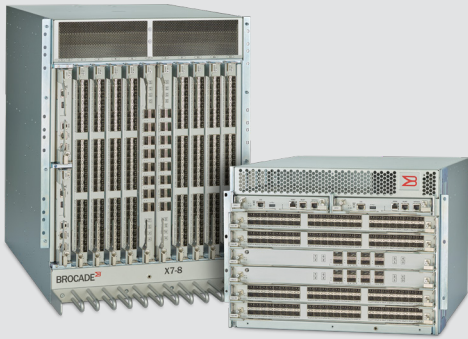## A Faster, More Intelligent, More Resilient Foundation for the On-Demand Data Center

Highlights

- Scale more devices, applications, and workloads with up to 512 64G links per chassis

- Maximize NVMe and high-transaction workloads with 50% lower network latency

- Transform telemetry data into actionable insights to optimize performance and ensure reliability

- Automate actions to simplify management and resolve issues without intervention

- Increase visibility and simplify operations with a modern SAN management tool

- Safeguard mission-critical workloads from vulnerabilities with Gen 7 integrated security

- Seamlessly integrate next-generation NVMe into the storage fabric without a disruptive rip-and-replace

- Design flexible architectures to increase agility with concurrent Fibre Channel, NVMe, FICON, FCIP, or IP storage connectivity

- Extend replication over distance with a highly scalable extension solution for Fibre Channel, IP, and FICON

Overview

Technology is evolving at an incredible pace, and businesses are demanding more from their IT resources and infrastructure. Rapid adoption of flash storage and the ramp-up of NVMe-based storage unleash advancements in application design that drive new levels of performance and capacity requirements, such as advanced analytics, business intelligence, and data-intensive workloads. With the integration of new technologies that are accelerating the delivery of data and services, the network will need to evolve to keep pace with innovations in storage and demands of modern applications to maximize the full value of investments in next-generation data center infrastructure.

To meet ever-increasing demands for faster, more reliable data access, it is essential for organizations to deploy a modernized infrastructure that reduces latency, increases bandwidth, and ensures continuous availability. Unprecedented performance is not enough on its own. Powerful analytics and advanced automation capabilities are required to transform current storage networks into an autonomous SAN. This requires a network that is capable of delivering these capabilities to maximize performance, simplify management, and reduce operational costs. Legacy infrastructure was not designed to support the performance requirements of evolving workloads and NVMe-based storage. In fact, an aging network will impede the performance of the on-demand data center. By modernizing the storage network with Brocade® Gen 7, organizations will enable a faster, more intelligent, and more resilient network. This will maximize the performance, productivity, and efficiency of their storage investments and resources, even as they rapidly scale their environments.

The Brocade X7 Director provides a modular building block, purpose-built for scalability to accommodate growth and power large-scale storage environments. With a 50% latency reduction compared to the previous generation, Brocade X7 Directors maximize the performance of NVMe storage and high-transaction workloads, eliminating I/O bottlenecks and unleashing the full performance of next-generation storage. In addition, the Brocade X7 Director lays the foundation for the autonomous SAN. With autonomous SAN technology, the director harnesses the power of analytics and the simplicity of automation to optimize performance, ensure reliability, and simplify management. Leveraging these capabilities enables organizations to realize a self-learning, self-optimizing, and self-healing SAN. In addition, the Brocade X7 Director provides cyber-resiliency with integrated security technology that protects mission-critical operations by validating the integrity of Gen 7 hardware and software. With enhanced security and autonomous SAN technology, organizations can take the guesswork out of protecting and managing a network.

Brocade X7 Directors provide up to 384 64G ports or up to 512 32G ports, enabling organizations to scale more devices, applications, and workloads. With diverse deployment options, multiprotocol

Gen 7 Fibre Channel

Brocade Gen 7 Fibre Channel is the modern storage network infrastructure for mission-critical storage, enabling organizations to realize a self-learning, self-optimizing, and self-healing autonomous SAN. It combines powerful analytics, advanced automation, and integrated security capabilities to accelerate data access, adapt to evolving requirements, and drive always-on business operations. The Brocade X7 Director with Gen 7 Fibre Channel and Brocade Fabric Vision® technology is the foundational building block to realize the autonomous SAN for the on-demand data center. Ultra-low latency and 64G links provide the highest level of performance for NVMe workloads. With data-center-proven reliability, seamless scalability, integrated analytics, and automation, the Brocade X7 maximizes the performance, productivity, and efficiency of storage investments and resources.

Unmatched Mainframe Technology Innovation and Leadership

The Brocade X7 Director delivers seamless FICON connectivity for mainframe storage environments. The Brocade X7 complements System Z mainframes by offering the industry's fastest, most reliable, and scalable FICON infrastructure, along with unique, innovative features—all of which help deliver the greatest ROI. Brocade, a Broadcom company, builds on more than 25 years of mainframe leadership that includes contributing to the FICON standard and authoring many FICON patents.

flexibility, and mixed blade capability, organizations can adapt and optimize their businesses to meet next-generation storage and server requirements. The Brocade X7 Director supports the concurrent use of both traditional Fibre Channel and NVMe storage traffic over FC or IP, allowing organizations to seamlessly integrate Brocade Gen 7 Fibre Channel networks with next-generation NVMe-based storage, without a disruptive rip-and-replace.

Modern Modular Building Block Designed for Enterprise Deployments

Designed to meet continuous data growth and critical application demands, the Brocade X7 Director is purpose-built to power large-scale Fibre Channel and IP storage environments that require increased capacity, greater throughput, and higher levels of resiliency and operational efficiency. This modular building block enables organizations to build the highest performing data center SAN fabric that is required for all-flash and NVMe storage environments. The Brocade X7 Director modular design provides flexibility with two customizable chassis that can scale on-demand for more devices, applications, and workloads. Both chassis utilize Brocade UltraScale inter-chassis link (ICL) technology to scale out modular SANs while preserving blade ports for device connectivity and allowing flexible SAN design that supports core-edge or mesh topologies.

The 14U Brocade X7-8 Director is built for large enterprise networks and has eight vertical blade slots to provide up to 384 64G ports or up to 512 64G ports for device connectivity. An additional 32 UltraScale ICL connections provide 128 ports for chassis-to-chassis interconnect.

The 8U Brocade X7-4 Director in built for midsize networks and has four horizontal blade slots to

provide up to 192 64G ports or up to 256 32G ports for device connectivity. An additional 16 UltraScale ICL connections provide 64 ports for chassis-to-chassis interconnect.

Each blade slot within the Brocade X7 chassis can be populated with optional port or extension blades. For device connectivity, the following blades are available:

- The Brocade FC64-48 Fibre Channel port blade provides 48 x 64G Fibre Channel ports with backward-compatibility support for 8, 10, 16, and 32G Fibre Channel connectivity. The Up to 24 ports per blade can also be configured as are AnyIO ports with backward-compatibility support for 8, 10, 16, and 32G Fibre Channel connectivity with support for both Fibre ChannelC and 10, and 25 and 50GbE IP connectivity. The 24 AnyIO ports require 64G SWL SFP+ transceivers. The 64G SWL SFP+ transceiver dynamically changes to Fibre Channel or Ethernet depending on the port configuration.

- The Brocade FC64-64 Fibre Channel port blade with 32 SFP-DD ports provides 64 x 64G Fibre Channel ports with backward-compatibility support for 8, 16, and 32G Fibre Channel connectivity.

- The Brocade FC32-X7-48 Fibre Channel port blade provides 48 x 32G Fibre Channel ports with backward-compatibility support for 4, 8, 10, and 16G Fibre Channel connectivity.

- The Brocade FC32-48 Fibre Channel port blade provides 48 x 32G Fibre Channel ports with backward-compatibility support for 4, 8, 10, and 16G Fibre Channel connectivity.

- The Brocade SX6 Extension blade provides 16 x 32G Fibre Channel ports, 16 x 1GbE/10GbE ports, and 2 x 40GbE ports.

Autonomous SAN

The combination of SAN analytics and automation technologies is unlocking the capabilities to deliver a self-learning, self-optimizing, and self-healing autonomous SAN.

Self-Learning:

• Gather and transform billions of data points into network intelligence.

• Visualize application and device-based performance and health metrics.

• Detect abnormal traffic behaviors and degraded performance.

• Eliminate operational steps by automatically learning application flows.

Self-Optimizing:

• Optimize critical application performance by automatically prioritizing traffic.

• Guarantee application performance by proactively monitoring and actively shaping traffic.

• Eliminate human errors and performance impacts through open DevOps automation technology.

• Optimize administrative resources with cloud-like SAN orchestration

Self-Healing:

• Instantly notify end devices of congestion for automatic resolution.

• Ensure data delivery with automatic failover from physical or congestion issues.

• Detect and automatically reconfigure out-of-compliance fabrics.

• Eliminate performance impacts by automatically taking corrective action on misbehaving devices.

To deploy or consolidate IP storage within data centers, the Brocade FC64-48 port blade provides Brocade Unified Storage Fabric (USF) capability that enables transport of both Fibre Channel and IP storage traffic on the same fabric. Brocade USF is supported on 24 AnyIO ports per blade, enabling IP storage to leverage fabric services, centralized management, and the inherent dual fabric architecture of the Brocade Fibre Channel SAN, providing the highest levels of redundancy, resiliency, performance and security. This enables enterprises to leverage existing or future investments in Brocade Gen 7 Fibre Channel and IP infrastructure, using a common optical transceiver for added flexibility and investment protection.

To create high-scale fabrics, the Brocade FC64-64 port blade scales the Brocade X7-8 Director up to 512 x 64G ports and the Brocade X7-4 Director up to 256 x 64G ports. This blade increases the total system bandwidth up to 39.6Tb/s to handle more workloads, making it ideal for large-scale enterprise infrastructures. The Brocade FC64-64 blade utilizes SFP-DD transceivers, enabling 33% more device connectivity in a very dense footprint. Each SFP-DD port provides two ports for device or ISL connectivity with SN connectors, port speed is configurable independently for each port. These ports are capable of 2×64G, 32G, or 16G utilizing the SFP-DD transceivers or 64G, 32G, 16G, or 8G using SFP+ transceivers. Leveraging this efficient, high-density designed blade, organizations can consolidate more device connectivity into a single fabric and reduce capital expenses by consuming less rack space. By utilizing fewer chassis, it lowers operational cost by reducing power consumption, cooling, and management. With industry-leading port density and increased bandwidth,

organizations can effectively scale to meet data growth demands and drive efficiency by maximizing space utilization with room for future scaling of demanding IT applications.

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 32G Fibre Channel ports, 16 1GbE/10GbE ports, and 2 40GbE ports. This blade allows organizations to seamlessly integrate extension capabilities within the Brocade X7 Director to provide replication services for large-scale, multisite data center environments that implement block, file, and tape data protection solutions. The Brocade SX6 Extension Blade can be deployed with the Brocade 7840 Extension Switch and the Brocade 7810 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.

Brocade directors build upon years of innovation and leverage the core technology of Brocade systems to consistently deliver five-nines availability in the world's most demanding data centers. Delivering nondisruptive software upgrades, hot-pluggable components, and a no-single-point-of-failure design, the Brocade X7 offers a highly resilient solution for today's enterprise-class storage environments.

Protect Mission-Critical Workloads with Gen 7 Integrated Security

The sophistication and volume of cybercriminal behavior have dramatically increased as a direct result of the added reliance on digital data by businesses. Counterfeiting and tampering

with hardware and software have become a lucrative illegal trade that leads to billions of dollars in losses across all industries. This counterfeiting and tampering within the data center can cause serious damage and risk to your environment.

A Brocade Gen 7 cyber-resilient network protects against security threats, enables nonstop operations, and maximizes management automation. Fibre Channel fabrics are secure by design based on controlled access between servers and storage and isolation within the data center. Brocade Gen 7 technology further reduces the risk of vulnerabilities from malware and hijacking attacks by validating the integrity of the switch operating system, security settings, and hardware.

Brocade Fabric OS® (FOS) adds additional security enhancements to validate the integrity and security of Brocade hardware and software. These features include Secure Boot, Brocade Trusted FOS (TruFOS) Certificates, FOS hardening with removal of root access, and automated distribution of SSL certificates through SANnav™ Management Portal. Brocade TruFOS Certificates ensure that enterprises running Brocade directors and switches are currently covered with support and securely enabled to perform critical operations without having to worry about whether the operating system has been tampered with. In addition, Brocade has hardened FOS by removing root-level access to the operating system to protect the SAN against malware and hijacking attacks.

Those enterprises using Brocade SANnav Management Portal have the ability to automatically distribute SSL certificates across the SAN to ensure authenticity and encryption settings. In addition, Brocade SANnav Management Portal has built-in security features to help protect the network. With

Brocade SANnav, administrators can set up monitoring and alerting for security configuration changes, customize security thresholds, give proper access control to individual admins, and view switch security events.

Autonomous SAN Innovation

The Brocade X7 Director with Fabric Vision technology provides a robust analytics architecture that delivers autonomous SAN technology through self-learning, self-optimizing, and self-healing capabilities. Brocade Fabric Vision technology is a collection of features that leverage comprehensive data collection capabilities with powerful analytics to quickly understand the health and performance of the environment and identify any potential impacts or trending problems.

Analyze the SAN to Optimize Performance and Reliability

IT organizations are responsible for delivering nonstop performance and reliability to ensure that service-level agreements (SLAs) are met. They need analytics to help extract actionable intelligence from their environment and simplified management tools to quickly and easily understand the state of their environment. This requirement needs an infrastructure that can automatically learn its performance and health characteristics, identify potential risks, and provide recommended actions to resolve issues.

With Gen 7, Brocade products enable a self-learning SAN that gathers and transforms billions of data points into actionable intelligence to make fast, informed decisions to optimize performance and ensure reliability. Brocade products proactively monitor I/O performance and behavior data

points through integrated network sensors to gain deep insight into the environment. The information captured is displayed in Brocade SANnav Management Portal to quickly identify and isolate problems before they impact application availability. With built-in best practice recommendations, organizations can simplify troubleshooting by identifying and isolating issues to resolve them as fast as possible. Combining these tools with automation, Brocade technology can detect abnormal traffic behaviors and degraded performance to automatically take corrective action, eliminating the potential impact of this issue. These new autonomous SAN technologies greatly simply SAN management and enable unparalleled network performance and reliability.

Automate the SAN to Simplify Management Complexity

IT organizations spend nearly half of their time performing repetitive daily management tasks, such as zoning, inventory reporting, and operational validation checks. By automating these repetitive tasks, IT organizations can significantly improve their efficiency and dramatically 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 Brocade automation, the Brocade X7 Director can automate actions to simplify management and resolve issues without intervention to avoid network disruptions and outages. Through open DevOps automation technology, organizations can reliably perform resource-intensive tasks, such as infrastructure deployment and provisioning, in a fraction of the time to expedite IT services, while eliminating human error. In addition,

automation proactively monitors the network to self-optimize performance and automatically mitigate fabric-related issues with self-healing capabilities.

With self-optimizing capability, Brocade technology utilizes actionable intelligence to maximize performance. Real-time monitoring of heath and performance characteristics enables the network to make smarter decisions on traffic prioritization, congestion management, and notification to ensure optimal network performance for applications and storage. Brocade Traffic Optimizer guarantees critical application performance by automatically prioritizing traffic. This advanced capability classifies and separates traffic with similar characteristics such as protocol, speed, and latency. In addition, Traffic Optimizer can help avoid application performance impacts by automatically isolating traffic adversely impacting other flows.

Brocade Gen 7 raises the bar for network availability through automatic avoidance and recovery features, delivering a self-healing SAN. When detection of potential disruptions occurs, the network will automatically mitigate or resolve issues without intervention. Brocade software identifies abnormal or unexpected behavior and automatically takes action to avoid a degradation in performance. If congestion occurs, it will instantly notify end devices of the congestion problem through an alerting and signaling process. Once they are alerted, the software ensures data delivery with automatic failover or adjustment of traffic to mitigate the impact of the problem. Brocade SAN management tools can identify various latency severity levels, pinpointing exactly which devices are causing the issues or are impacted by a bottleneck, and quarantine misbehaving devices automatically.

Instant Visibility and Simplified Processes

Brocade SANnav Management Portal and SANnav Global View empower IT administrators with comprehensive visibility across the entire SAN, from a global view down to local environments. By contextualizing data into visual dashboards and topology views, administrators can quickly detect and isolate points of interest to increase operational efficiencies. In addition, Brocade SANnav streamlines management workflows to accelerate the deployment of new applications, switches, servers, and storage. All of the SAN telemetry data collected by SANnav Management Portal can also be streamed to third-party applications through Kafka streaming.

Maximum Performance for the On-Demand Data Center

Evolving critical workloads and higher density virtualization are continuing to demand greater, more predictable performance. The Brocade X7 Director features industry-leading Gen 7 Fibre Channel that increases performance for demanding workloads across 64G links and up to 39.6Tb/s of chassis bandwidth to address next-generation I/O-intensive and bandwidth-intensive applications. This breakthrough performance speeds up data-intensive application response times and allows more transactions in less time, ultimately improving SLAs. In addition, the Brocade X7 Director increases scalability with double the throughput for high-density virtual machine (VM) deployments and larger fabrics. This allows organizations to support more storage devices and meet bandwidth requirements.

Brocade X7 Directors provide unmatched chassis, slot-to-slot, and port performance, delivering the lowest port-to-port latency for any director. For the lowest possible latency, local switching enables data traffic in the same port group to switch within a single ASIC, instead of going through the chassis backplane.

The Brocade X7 Director features IO Insight for nonintrusive, real-time monitoring of NVMe workloads, helping to ensure optimal performance. IO Insight monitors I/O performance and behavior through integrated network sensors, providing deep insight into problems and helping to ensure service levels. This capability nondisruptively and nonintrusively gathers I/O statistics from any device port and then feeds them to a monitoring policy that sets thresholds and generates alerts. VM Insight applies the IO Insight visibility for each VM. Integrated VM, application, and device-level I/O latency and IOPS monitoring enable administrators to set baseline application performance and identify the VM or physical layer responsible for the degraded performance. Integrated network sensors provide I/O performance management to avoid dependence on invasive and disruptive physical taps.

Simplified Scale-Out Network Design

Organizations need to adapt to continuous data growth and seamlessly scale out their storage environments. Brocade UltraScale chassis connectivity leverages optical Inter-Chassis Links (ICLs). These links can connect up to 12 Brocade Gen 5, Gen 6, or Gen 7 directors, enabling flatter, faster, and simpler fabrics that increase consolidation while reducing network complexity and costs.

UltraScale ICLs are QSFP-based and enable scalable core-edge and active-active mesh chassis topologies. These high-density chassis topologies reduce inter-switch cabling by 75%. With the UltraScale ICL connections residing on the core routing blades instead of consuming ports on the port blades, up to 33% more device ports are available for server and storage connectivity. This maximizes overall port density within the smallest amount of rack space while freeing up front-facing device ports for server and storage connectivity.

Extended Distance and Replication with a Scalable, Multiprotocol Extension Solution

Connecting distributed data centers enables data mobility for advanced data protection. Enterprise data centers need a disaster recovery infrastructure to ensure fast, continuous, and easy replication of mission-critical data to anywhere in the world. Storage administrators need to replicate large amounts of data quickly, securely, reliably, and simply while minimizing operational and capital expenses.

With the Brocade SX6 Extension Blade, the Brocade X7 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 X7 Director can scale up to four Brocade SX6 Extension Blades per chassis. Each Brocade SX6 Extension Blade provides 16 32G Fibre Channel/FICON ports, 16 1GbE/10GbE 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.

Brocade Fabric Vision technology with SANnav Management Portal provides insight and visibility for connections between data centers, as well as the fabrics within each data center. With its powerful, integrated monitoring, management, and diagnostic tools, Fabric Vision technology enables organizations to minimize the impact of disruptions and outages for nonstop business operations. Fabric Vision monitors replication traffic for both Fibre Channel and IP storage. Brocade SANnav Management Portal visualizes the traffic for Fibre Channel and IP storage through in-context topology views to simplify managing complex multifabric environments.

Adapting to Storage Requirements with Flexible Deployment Options

To realize the full benefits of flash, organizations will need to transition their high-performance, latency-sensitive workloads to flash-based storage with NVMe connectivity. The simplicity and efficiency of NVMe enable significant performance gains for flash storage.

The Brocade X7 Director enables flexibility with multiprotocol connectivity, allowing administrators to seamlessly adapt to next-gen requirements and design architectures with concurrent Fibre Channel or IP storage connectivity options. Organizations can seamlessly integrate Brocade Gen 7 Fibre Channel networks with NVMe without a disruptive rip-and-replace. Leveraging the efficiency of NVMe, combined with the high performance and low latency of Brocade Gen 7 Unified Storage Fabrics, organizations can accelerate IOPS to deliver the performance, application response time, and scalability needed for next-generation data centers. Using the Brocade FC64-48 port blade, the Brocade X7 Director provides IP storage connectivity to support flexible architectures for increased agility with a single point of SAN administration.

For investment protection, Brocade X7 Directors offer three generations of backward-compatibility support for connectivity to 8G, 16G, and 32G Fibre Channel products. Furthermore, the Brocade X7 supports mix-and-match blades, allowing for Gen 6 and Gen 7 blades to be installed within the chassis.

Brocade Global Support

Brocade Global Support has the expertise to help organizations build resilient, efficient SAN infrastructures. Leveraging 25+ years of expertise in storage networking, Global Support delivers world-class technical support, implementation, and migration services to enable organizations to maximize their hardware and software investments, accelerate new technology deployments, and optimize the overall performance of their network.

Maximizing Investments

To help optimize technology investments, Brocade, a Broadcom company, and its partners offer complete solutions that include professional services, technical support, and education. For more information, contact a Brocade sales partner or visit broadcom.com/brocade.

Brocade X7 Director Specifications

System Architecture	
Chassis	**Single Chassis:** **Brocade X7-8:** Nonblocking architecture • X7-8 Director with 48 64G port blades: 30.9Tb/s of aggregate chassis bandwidth (384 device ports with a 64G data rate plus 32 4xGen7 ICLs) • X7-8 Director with 64 64G port blades: 39.6Tb/s of aggregate chassis bandwidth (512 device ports with a 64G data rate plus 32 4xGen7 ICLs) • X7-8 Director with 64 32G port blades: 22.8Tb/s of aggregate chassis bandwidth (512 device ports with a 32G data rate plus 32 4xGen7 ICLs) **Brocade X7-4:** Nonblocking architecture • X7-4 Director with 48 64G port blades: 15.7Tb/s of aggregate chassis bandwidth (192 device ports with a 64G data rate plus 16 4xGen7 ICLs) • X7-4 Director with 64 64G port blades: 19.8Tb/s of aggregate chassis bandwidth (256 device ports with a 64G data rate plus 16 4xGen7 ICLs) • X7-4 Director with 64 32G port blades: 11.4Tb/s of aggregate chassis bandwidth (256 device ports with a 32G data rate plus 16 4xGen7 ICLs) Each provides support for (E, F, D, M, SIM, and EX) Fibre Channel ports using Fibre Channel blades.
Control processor	Redundant (active/standby) control processor modules.
Scalability	Full-fabric architecture of 239 switches.
Certified maximum	6000 active devices per switch; 56 switches, 19 hops in Brocade FOS fabrics; larger fabrics certified as required.
Fibre Channel blades	Brocade FC64-48 port blade provides 48 ports of 64G Fibre Channel and up to 24 ports of 10/25/50GbE IP connectivity. Brocade FC64-64 port blade provides 64 ports of 64G Fibre Channel. Brocade FC32-X7-48 port blade provides 48 ports of 32G Fibre Channel. Brocade FC32-48 port blade provides 48 ports of 32G Fibre Channel.
Extension blades	Brocade SX6 Extension Blade provides Fibre Channel extension (16×32G Fibre Channel ports) and IP extension over IP networks (16×1GbE/10GbE and 2×40GbE ports).
Performance	**Brocade FC64-48 Port Blade:** Fibre Channel: 8.5Gb/s line speed, full duplex; 10.53Gb/s line speed, full duplex; 14.025Gb/s line speed, full duplex; 28.05Gb/s line speed, full duplex; 57.8Gb/s line speed, full duplex. Autosensing of 8, 16, 32, and 64G port speeds depending on SFPs used. 10G port speeds with dedicated SFPs. AnyIO Ports: 24 AnyIO ports can be configured as Fibre Channel or IP. Supports 8, 16, 32, and 64G Fibre Channel or 10, 25 and 50GbE IP speeds. Support for 10, 25, and 50GbE speeds requires the use of the 64G SWL SFP+ transceiver. **Brocade FC64-64 Port Blade:** Fibre Channel: 8.5Gb/s line speed, full duplex; 14.025Gb/s line speed, full duplex; 28.05Gb/s line speed, full duplex; 57.8Gb/s line speed, full duplex. Autosensing of 8, 16, 32, and 64G port speeds depending on SFPs used. Support for 8G requires a 32G SFP+ LWL or ELWL transceiver. **Brocade FC32-X7-48 Port Blade:** Fibre Channel: 4.25Gb/s line speed, full duplex; 8.5Gb/s line speed, full duplex; 10.53Gb/s line speed, full duplex; 14.025Gb/s line speed, full duplex; 28.05Gb/s line speed, full duplex. Autosensing of 4, 8, 16, and 32G port speeds depending on SFPs used. 10G port speeds with dedicated SFPs. **Brocade FC32-48 Port Blade:** Fibre Channel: 4.25Gb/s line speed, full duplex; 8.5Gb/s line speed, full duplex; 10.53Gb/s line speed, full duplex; 14.025Gb/s line speed, full duplex; 28.05Gb/s line speed, full duplex. Autosensing of 4, 8, 16, and 32G port speeds depending on SFPs used. 10G port speeds with dedicated SFPs.
ISL trunking	Frame-based trunking with up to eight 64G SFP+ ports per ISL trunk; up to 512Gb/s per ISL trunk between switches using 8G, 16G, 32G, or 64G ports; Exchange-based load balancing across ISLs with DPS included in Brocade FOS.
UltraScale ICL trunking	Chassis-to-chassis linkage through connectors on the Core Routing (CR) blade. Can configure the following maximum number of QSFPs per trunk depending on blade type, connecting the following components: • Up to four QSFP ports in a trunk group between two Brocade CR64-4 blades. For trunks that contain four or fewer QSFP ports, ports in a trunk must be located in the same port group on each blade. • Up to four QSFP ports in a trunk group between a Brocade CR64-4 blade and a CR64-8 blade. For trunks that contain four or fewer QSFP ports, ports in a trunk must be located in the same port group on each blade. A minimum of two QSFP connections are required for a trunk, and up to four QSFP trunks between pairs of Brocade CR64-8 (CR64-4) and CR32-8 (CR32-4).
Multichassis with UltraScale ICL ports	Up to 4608 Fibre Channel ports; UltraScale ICL ports (32 for 8-slot or 16 per 4-slot chassis, optical QSFP) connect up to 9 chassis in a full-mesh topology or up to 12 chassis in a core-edge topology.
Chassis bandwidth	**Brocade X7-8:** 31Tb/s per chassis with 384 device ports + 32 UltraScale ICL connections supporting 128 ports. **Brocade X7-8:** 39.6Tb/s per chassis with 512 device ports + 32 UltraScale ICL connections supporting 128 ports. **Brocade X7-4**: 15.7Tb/s per chassis with 192 device ports + 16 UltraScale ICL connections supporting 64 ports. **Brocade X7-4:** 19.8Tb/s per chassis with 256 device ports + 16 UltraScale ICL connections supporting 64 ports.

Slot bandwidth	3072Gb/s providing line-rate performance for the Brocade FC64-48 blade. 4096Gb/s providing line-rate performance for the Brocade FC64-64 blade.
Maximum frame size	2112-byte payload.
Frame buffers	24,000 per switching ASIC.
Classes of service	Class 2, Class 3, Class F (inter-switch frames).
Fibre Channel port types	**CR64-8 and CR64-4 CR blades:** E_Port, EX_Port, and D_Port. **FC64-48, FC32-X7-48, FC32-48, FC64-64 port blades:** F_Port, E_Port, EX_Port, M_Port, SIM, and D_Port. **SX6 extension blade:** F_Port, FL_Port, E_Port, SIM, and EX_Port on FC and VE_Port on GbE. Self-discovery is based on switch type (U_Port) with an optional port type control.
AnyIO ports	**FC64-48 port blade:** 24 ports on the blade (ports 16-23 and 32-47).
Data traffic types	Fabric switches supporting unicast.
Media types	**Brocade FC64-48 port blade:** 64G FC SFP+ LC connector: SWL, LWL, ELWL 32G FC SFP+ LC connector: SWL, LWL, ELWL 10G FC SFP+ LC connector: SWL, LWL **Brocade FC64-64 port blade** 64G FC SFP-DD SN connector: SWL 64G FC SFP+ LC connector: SWL, LWL 32G FC SFP+ LC connector: LWL, ELWL **Brocade FC32-X7-48 port blade:** 32G FC SFP+ LC connector: SWL, LWL, ELWL 16G FC SFP+ LC connector: SWL, LWL, ELWL 10G FC SFP+ LC connector: SWL, LWL **Brocade FC32-48 port blade** 32G FC SFP+ LC connector: SWL, LWL, ELWL 16G FC SFP+ LC connector: SWL, LWL, ELWL 10G FC SFP+ LC connector: SWL, LWL **Brocade SX6 Extension Blade:** 32G FC SFP+ LC connector: SWL, LWL, ELWL 16G FC SFP+ LC connector: SWL, LWL, ELWL 10G FC SFP+ LC connector: SWL, LWL Ethernet QSFP+ MPO connector: 40GBASE-SR4, 40GBASE-LR4, 40GBASE-ER4 Ethernet QSFP+ LC connector: 40GbE BiDi 10GbE SFP+ LC connector: SR, LR, USR 1GbE SFP+ LC connector: SR, LR 1GbE SFP+ copper connector **Core Routing (CR) blades, Brocade CR64-4 and CR64-8:** Gen 7 FC QSFP+ MMF, MPO connector: SWL 100m Gen 7 FC QSFP+ SMF, LC connector: LWL 2 km* 4x32G FC QSFP+ MMF, MPO connector: SWL 100m Note: MPO connectors require 1×12 ribbon cable up to 66m over OM3 or 100m over OM4/OM5. *Use of the Gen 7 2-km ICL QSFP is subject to the following environmental ratings for maximum intake air tempera-ture: 0–40°C at sea level; 0–35°C up to 1500m (4921 ft) elevation; and 0–30°C from 1500m to 3000m (9843 ft) elevation. All Brocade transceivers are PC/UPC compatible.
USB	One USB port per control processor for firmware download, SupportSave, and configuration upload or download.
Fabric services	BB Credit Recovery; Brocade Advanced Zoning (Default Zoning, Port/WWN Zoning, Peer Zoning); Congestion Signaling; Dynamic Path Selection (DPS); Extended Fabrics; Fabric Performance Impact Notification (FPIN); Fabric Vision; FDMI; FICON CUP; Flow Vision; F_Port Trunking; FSPF; Integrated Routing; ISL Trunking; Management Serv-er; Name Server; NPIV; NTP v3; Port Decommission/Fencing; QoS; Registered State Change Notification (RSCN); Target-Driven Zoning; Traffic Optimizer; Virtual Fabrics (Logical Switch, Logical Fabric); VMID+ and AppServer.
Extension	Supports DWDM, CWDM, and FC-SONET Devices; Fibre Channel; In-flight Compression (Brocade LZO) and Encryption (AES-GCM-256); BB Credit Recovery; FCIP; IP Extension; Adaptive Rate Limiting (ARL); Data Compres-sion; Fast Write; Read/Write Tape Pipelining; QoS.
FICON	FICON cascading; support for lossless DLS; FICON CUP; Advanced Accelerator for FICON (IBM z/OS Global Mirror and read/write Tape Pipelining). (FICON connectivity is not supported on the FC64-64 Blade.)
Unified storage fabric (USF)	IP storage support with the IPS logical switch that is available on the Brocade X7-8 and X7-4 directors with the Brocade FC64-48 port blade.

System Components	
Fibre Channel ports	**Brocade X7-8:** Up to 512 64G ports, universal (E_Port, F_Port, EX_Port, M_Port, D_Port, SIM Port, FICON*). **Brocade X7-4:** Up to 265 64G ports, universal (F_Port, E_Port, EX_Port, M_Port, D_Port, SIM Port, FICON*). *Brocade 48 port blade is required.
Classes of service	Class 2, Class 3, Class F (inter-switch frames).
ANSI Fibre Channel protocol	FC-PH (Fibre Channel Physical and Signaling Interface standard).
Port-to-port latency	Local switching: 460 ns at 64G (including FEC as part of the FC standard). Blade-to-blade: 1.4 µs.

High Availability	
Architecture	Nonblocking shared memory; passive backplane; redundant active/passive control processor; redundant active/active core switching blades; redundant WWN cards.
Chassis power	**Brocade X7-8** • Four power supplies required for AC low-line (100 VAC to 120 VAC). • Two power supplies required for AC high-line (200 VAC to 240 VAC). • Two power supplies required for high voltage AC (200 VAC to 277 VAC) or high voltage DC (240 VDC to 380 VDC). • Chassis ships empty only. PSU and fans must be ordered separately. Three PSUs are required for 2+1 redundancy. Two PSUs provide system power, but four PSUs must be installed to provide power efficiency and 2+2 redundancy. **Brocade X7-4** • Two power supplies required for AC low-line (100 VAC to 120 VAC). • One power supply required for AC high-line (200 VAC to 240 VAC). • One power supply required for high voltage AC (200 VAC to 277 VAC) or high voltage DC (240 VDC to 380 VDC). • Chassis ships empty only. PSU and fans must be ordered separately. One PSU provides system power, but both PSUs must be installed to provide power efficiency and 1+1 redundancy.
Cooling	**Brocade X7-8** • Requires three fan tray assemblies. A failure condition is one failed fan from any fan tray. • Each assembly contains two fans for a total of six fans. The system requires five of six functioning fans for operation in the Brocade X7-8. One fan tray assembly can be hot-swapped and should be replaced immediately in the event of a failure. **Brocade X7-4** • Requires two fan tray assemblies. A failure condition is one failed fan from any fan tray. • Each assembly contains two fans for a total of four fans. The system requires three of four functioning fans for operation in the Brocade X7-4. One fan assembly can be hot-swapped and should be replaced immediately in the event of a failure.
Airflow	Non-port-side intake (NPI) to port-side exhaust and port-side intake to non-port-side exhaust (NPE) options are available.
Solution availability	Designed to provide 99.999% uptime capabilities; hot-pluggable redundant power supplies, fans, WWN cards, processors, core switching, port blades, and optics; online diagnostics; nondisruptive firmware download and activation.

Management	
Management	Brocade Advanced Web Tools; Brocade SANnav Management Portal and SANnav Global View; Command Line Interface (CLI); HTTP/HTTPS; RESTful API; SSH; SNMP v1/v3 (FE MIB, FC Management MIB); trial licenses for add-on capabilities.
Security	AES-GCM-256 encryption on FC ISLs (E_Port); Device Connection Control (DCC); DH-CHAP (between switches and end devices); Fabric Configuration Server (FCS); FCAP switch authentication; FIPS 140-3 compliant; HTTPS; IP filtering; LDAP with IPv6; OpenLDAP; RADIUS; user-defined Role-Based Access Control (RBAC); Secure Boot; Secure Copy (SCP); SFTP; SSH v2; Switch Binding; TACACS+; TLS v1.2/v1.3; USGv6 compliant.
Management access	10/100/1000Mb/s Ethernet (RJ-45) per control processor; serial console port (RJ-45) and one USB per control processor module; DHCP/DHCPv6; call-home integration enabled through Brocade SANnav Management Portal.
Diagnostics	Active Support Connectivity (ASC) and Brocade Support Link (BSL); built-in flow generator; ClearLink™ optics and cable diagnostics, including electrical/optical loopback, link traffic/latency/distance; Fabric Performance Impact Monitoring (FPI); flow mirroring; Forward Error Correction; frame viewer; IO Insight for SCSI and NVMe monitoring; Monitoring and Alerting Policy Suite (MAPS); nondisruptive daemon restart; optics health monitoring; POST and embedded online/offline diagnostics, including environmental monitoring, FCping, and Pathinfo (FC traceroute); power monitoring; RAStrace logging; Rolling Reboot Detection (RRD); Syslog/Audit Log; VM Insight.

Mechanical Specifications

Enclosure	**Brocade X7-8 12-blade slots:** 14U rack-mountable chassis; 27 in. to 31 in. and 22 in. rail kits for the four-post rack; mid-mount kit for the two-post rack. **Brocade X7-4 8-blade slots:** 8U rack-mountable chassis; 27 in. to 31 in. rail, 18 in. to 24 in. rail, and airflow diversion rack-mount kits for the four-post rack; mid-mount kit for the two-post rack.
Mounting	Rack-mountable in a standard 19-inch EIA cabinet.
Size	**Brocade X7-8** Height: 61.23 cm (24.11 in., 14U) Width: 43.74 cm (17.23 in.) Depth: 61.04 cm (24.04 in.) **Brocade X7-4** Height: 34.45 cm (13.56 in., 8U) Width: 43.74 cm (17.23 in.) Depth: 61.04 cm (24.04 in.) **Brocade X7-4 with airflow diversion rack-mount kit** Height: 40.00 cm (15.75 in., 9U) Width: 43.74 cm (17.23 in.) Depth: 61.29 cm (24.09 in.)
System weight	**Brocade X7-8** 35.61 kg (78.5 lb) for chassis 145.8 kg (321.5 lb) maximum fully populated configuration **Brocade X7-4** 24.5 kg (54 lb) for chassis 68.95 kg (152.0 lb) maximum fully populated configuration

Environment

Temperature	Operating: 0°C to 40°C (32°F to 104°F). Nonoperating: –25°C to 70°C (–13°F to 158°F).
Humidity	Operating humidity: 5% to 93% RH noncondensing at 40°C (104°F) with a maximum gradient of 10% per hour. Nonoperating humidity: 10% to 93% RH noncondensing at 70°C (158°F).
Altitude	Up to 3000 meters (9842 feet).
Shock	Operating: 10g, 11 ms, half sine wave. Nonoperating: 20g, 11 ms, half sine wave.
Vibration	Operating: 5 Hz to 10 Hz at +5 dB/oct; 10 Hz to 200 Hz at 0.0005 G^2/Hz; 200 Hz to 500 Hz at –5 dB/oct; scale 0.5 grms. Nonoperating: 3 Hz to 10 Hz at +5 dB/oct; 10 Hz to 200 Hz at 0.0065 G^2/Hz; 200 Hz to 500 Hz at –5 dB/oct; scale 1.12 grms.
Heat dissipation	**Brocade X7-8** 64G 384-port configuration, including ICLs: Typical: 10,866 Btu/hr; Max: 16,041 Btu/hr. Power consumed: Typical: 3184W; Max: 4,700W. Note: Input power is at 200 VAC with full PSU redundancy. 64G 512-port configuration, including ICLs: Typical: 11,766 Btu/hr; Max: 16,942 Btu/hr. Power consumed: Typical: 3447W; Max: 4,964W. Note: Input power is at 200 VAC with full PSU redundancy. **Brocade X7-4** 64G 192-port configuration, including ICLs: Typical: 5934Btu/hr; Max: 7771 Btu/hr. Power consumed: Typical: 1738W; Max: 2277W. Note: Input power is at 200 VAC with full PSU redundancy. 64G 256-port configuration, including ICLs: Typical: 6384 Btu/hr; Max: 8221 Btu/hr. Power consumed: Typical: 1870W; Max: 2409W. Note: Input power is at 200 VAC with full PSU redundancy.

Power		
Supported power range	**Standard AC Power Supplies** *Input Voltage* Standard AC input: Range: 90 VAC to 264 VAC auto-volt Nominal: 100 VAC to 240 VAC *Power* 85 VAC to 132 VAC: 1450W 180 VAC to 264 VAC: 2870W *80 PLUS Platinum certified*	**High Voltage (HV) Power Supplies** *Input Voltage* Range: 90 VAC to 132 VAC Nominal: 100 VAC to 120 VAC Range: 180 VAC to 305 VAC Nominal: 200 VAC to 277 VAC Range: 192 VDC to 400 VDC Nominal: 240 VDC to 380 VDC *Power* 90 VAC to 132 VAC: 1450W 180 VAC to 305 VAC: 2870W 192 VDC to 400 VDC: 2870W
In-rush current	35A maximum, peak	
Frequency	50 Hz to 60 Hz (Nominal: 50 Hz to 60 Hz)	