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Product Brief

Brocade® 7840 Extension Switch

Unprecedented Performance and Availability for Replication and Backup Solutions

Highlights

- Moves more storage data between data centers to meet increasing disaster recovery objectives with industry-leading performance and scalability
- Encrypts storage data flows over distance at full line rate without a performance penalty
- Provides load balancing and network resilience with Brocade Extension Trunking to increase WAN utilization and protect against WAN link failures
- Consolidates Fibre Channel, FICON, and IP storage traffic from heterogeneous devices for high speed, high availability, and secure transport between data centers
- Delivers holistic management over distance for greater control and insight
- Achieves always-on business operations with non-disruptive firmware upgrades
- Extends proactive monitoring between data centers to automatically detect WAN anomalies and avoid unplanned downtime
- Enables pay-as-you-grow scalability with capacity-on-demand upgrades

Overview

Today's IT organizations are under pressure to keep pace with the growing avalanche of data traffic between data centers and the changes driven by virtualized application workloads within Fibre Channel and IP storage environments. Also faced with rising service-level agreement (SLA) requirements and recovery expectations, enterprise data centers need their 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.

To address this challenge, the Brocade® 7840 Extension Switch with Brocade Fabric Vision® technology delivers unprecedented performance, strong security, continuous availability, and simplified management to handle the unrelenting transfer of data between data centers.

A purpose-built data center extension solution for Fibre Channel and IP storage environments, the Brocade 7840 is designed for high-speed, secure transport of data between data centers while maintaining uptime. This enterprise-class solution enables storage and mainframe administrators to optimize and manage the use of WAN bandwidth, secure data over distance, minimize the impact of disruptions, and maintain SLAs.

Unprecedented Performance

The Brocade 7840 Extension Switch is a purpose-built extension solution that securely moves more data over distance faster while minimizing the impact of disruptions. With Gen 5 Fibre Channel, IP extension capability, and Brocade Fabric Vision technology, this platform delivers unprecedented performance, strong security, continuous availability, and simplified management to handle the unrelenting growth of data traffic between data centers in Fibre Channel, FICON, and IP storage environments.

A Purpose-Built Extension Platform for Disaster Recovery

The Brocade 7840 is an ideal platform for building a high-performance data center extension infrastructure for replication and backup solutions. It leverages any type of inter-data center WAN transport to extend open systems and mainframe storage applications over any distance. Without the use of extension, those distances are often impossible or impractical.

In addition, the Brocade 7840 addresses the most demanding disaster recovery requirements.

Extending Brocade Fabric Vision Technology between Data Centers

Brocade Fabric Vision technology, an extension of Gen 5 Fibre Channel, is supported on Brocade extension products to provide unprecedented insight and visibility across the storage network. With its powerful integrated monitoring, management, and diagnostic tools, Fabric Vision technology enables organizations to:

Simplify monitoring:

- Deploy more than 20 years of storage networking best practices with a single click to simplify the deployment of monitoring with predefined, threshold-based rules, actions, and policies
- Simplify troubleshooting of end-to-end I/O flows over distance with Fabric Vision monitoring and alerting
- Gain comprehensive visibility into disaster recovery and business continuity network health and performance using browser-accessible dashboards with drill-down capabilities

24 16 Gb/s Fibre Channel/FICON ports, 16 1/10-Gigabit Ethernet (GbE) ports, and two 40GbE ports provide the bandwidth, port density, and throughput required for maximum application performance over WAN connections.

Designed for maximum flexibility, this enterprise-class extension switch offers pay-as-you-grow scalability with capacity-on-demand upgrades. To meet current and future requirements, organizations can quickly and cost-effectively scale their WAN rate from 5 Gb/s to 40 Gb/s per platform via software licenses. With compression enabled, organizations can scale up to 80 Gb/s application throughput, depending on the type of data and the characteristics of the WAN connection.

The Brocade 7840 base configuration is a comprehensive bundle that includes a set of advanced services: FCIP, IP extension, Brocade Fabric Vision technology, Extension Trunking, Adaptive Rate Limiting, IPsec, compression, Open Systems Tape Pipelining (OSTP), FastWrite, Adaptive Networking, and Extended Fabrics. Optional value-add licenses for Integrated Routing (FCR), FICON Management Server (CUP), and Advanced FICON Accelerator are available to address challenging extension and storage networking requirements in open system and mainframe environments.

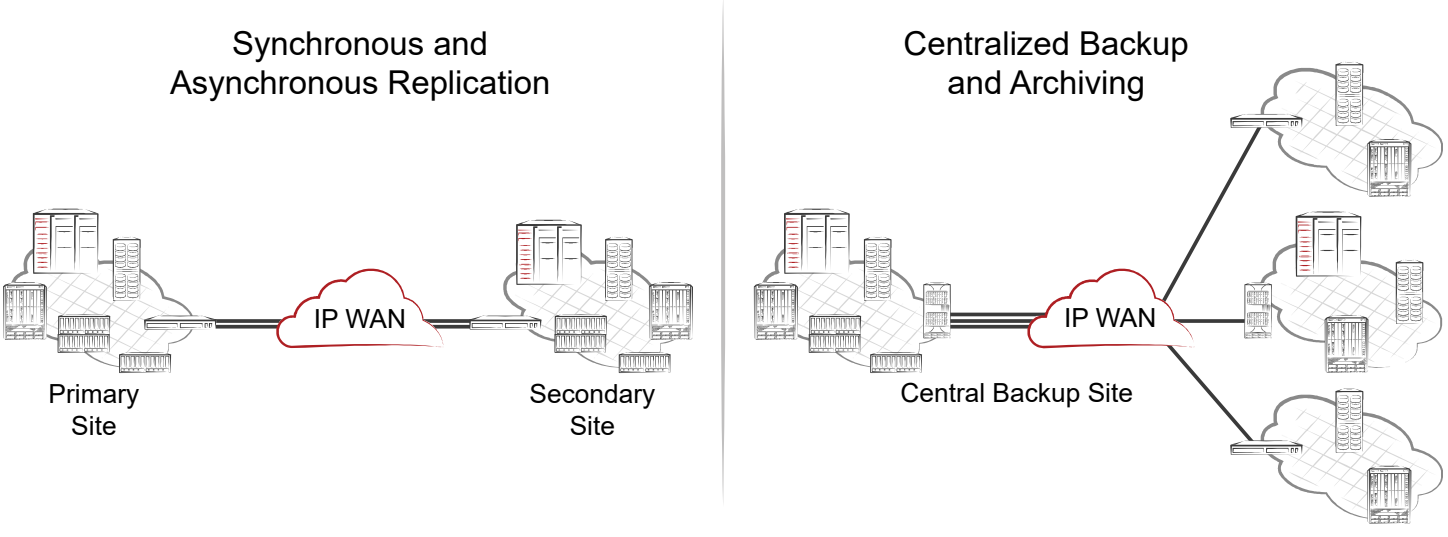
The Brocade 7840 is a robust platform for large-scale, multisite data center environments implementing block, file, and tape data protection solutions. It is ideal for:

- Data protection for open systems and mainframe
- Multisite synchronous and asynchronous storage replication
- Centralized tape backup, recovery, and archiving
- Consolidation of Fibre Channel, FICON, and IP storage data flows from heterogeneous arrays

Moving More Data Through Industry-Leading Performance and Scalability

The advanced performance and network optimization

The Brocade 7840 Provides Scalable Deployment Options to Extend Multiprotocol Disaster Recovery and Data Protection Storage Solutions over Long Distances



Extending Brocade Fabric Vision Technology between Data Centers (cont.)

Increase availability:

- Extend proactive monitoring between data centers to automatically detect WAN anomalies and address problems before they impact operations
- Facilitate planning to improve storage extension network capability, health, and stability through intuitive reporting and trend analysis
- Minimize downtime and accelerate troubleshooting with live monitoring, integrated diagnostics, and point-in-time playback

Dramatically reduce costs:

- Eliminate nearly 50% of maintenance costs through automated testing and diagnostic tools that validate the health, reliability, and performance of the network prior to deployment
- Save up to millions of dollars on CapEx by eliminating the need for expensive third-party tools through built-in monitoring and diagnostics
- Leverage specialized tools for pretesting and validating IT infrastructure to accelerate deployment, simplify support, and reduce operational costs

features of the Brocade 7840 enable replication and backup applications to send more data over metro and WAN links in less time, and optimize available WAN bandwidth. Supporting up to 250 ms Round-Trip Time (RTT) latency, the Brocade 7840 enables cost-effective extension solutions over distances up to 25,500 kilometers (15,845 miles).

The Brocade 7840 maximizes replication and backup throughput over distance using data compression, disk and tape protocol acceleration, WAN-optimized TCP, and other extension networking technologies. Advanced features and technologies include:

- Extension Trunking: Combines multiple WAN connections into a single, logical, high-bandwidth trunk, providing active load balancing and network resilience to protect against WAN link failures.
- Lossless Link Loss (LLL): Part of Extension Trunking, providing recovery of data lost in-flight when a link goes offline. From the perspective of the storage applications, nothing ever happened because all data is delivered—and delivered in order.
- Failover/failback with failover groups: Circuits are assigned metrics and put in a failover group. If all circuits of the lower metric within the failover group go offline, the higher metric circuits take over. This uses LLL, and all data is delivered and delivered in order. The storage application will not know that a failover/failback has occurred.
- Adaptive Rate Limiting (ARL): Dynamically adjusts bandwidth sharing between minimum and maximum rate limits to optimize bandwidth utilization and maintain maximum WAN performance during disruptions.
- IPsec: Ensures secure transport of data over WAN links without a performance penalty or excessive added latency by encrypting data-in-flight with a hardware-implemented, standard 256-bit AES algorithm.
- Unparalleled, extremely efficient architecture: Uniquely permits the high-speed, low-latency processing of IP datagrams and Fibre Channel/FICON frames, making extension of synchronous applications possible.
- WAN-optimized TCP: An aggressive TCP stack, optimizing TCP window size and flow control, and accelerating TCP transport for high-throughput storage applications.
- Streams: A feature of WAN-optimized TCP and used with Brocade IP extension to prevent Head-of-Line Blocking (HoLB) across the WAN.
- PerPriority TCP Quality of Service (PTQ): Provides high-, medium-, and low-priority handling of Fibre Channel and Brocade IP extension flows within the same tunnel for transmission over the WAN using autonomous individual TCP sessions per QoS priority.
- Advanced compression architecture: Provides multiple modes to optimize compression ratios for various throughput requirements.
- FCIP FastWrite (FCIP-FW): Accelerates SCSI write processing, maximizing performance of synchronous and asynchronous replication applications across high-latency WAN connections over any distance.
- Open Systems Tape Pipelining (OSTP): Accelerates read and write tape processing over distance, significantly reducing backup and recovery times over distance anywhere in the world.

- Advanced Accelerator for FICON: Uses advanced networking technologies, data management techniques, and protocol intelligence to accelerate IBM zGM, mainframe tape read and write operations, and z/OS host connection to Teradata warehousing systems over distance.

Ensuring Continuous Availability between Data Centers

Today's organizations depend on fast, reliable access to data wherever and whenever needed, regardless of location. The ramifications and potential business impact of an unreliable disaster recovery and data protection infrastructure are greater than ever.

The Brocade 7840 provides a suite of features—from pre-deployment validation to advanced network failure recovery technologies—to ensure a continuously available storage extension infrastructure.

The Brocade 7840 has built-in tools to validate conditions of the WAN links and network paths, as well as to validate the proper setup of configurations prior to deployment. Administrators can validate and troubleshoot the physical infrastructure with the built-in Flow Generator and WAN Test Tool (Wtool) to ease deployment and avoid potential issues.

Extension Trunking protects against WAN link failures with tunnel redundancy for lossless path failover and guaranteed in-order data delivery using LLL. The advanced Extension Trunking feature allows multiple network paths to be used simultaneously, and when there is a failure for a network path, Extension Trunking retransmits the lost packets to maintain overall data integrity. The storage application is protected with no disruption.

With Adaptive Rate Limiting, organizations can optimize bandwidth utilization and maintain full WAN performance of the link during periods when a path is offline due to an extension platform, IP network device, or array controller outage. Adaptive Rate Limiting uses dynamic bandwidth sharing between minimum (floor) and maximum (ceiling) rate limits to achieve maximum available performance during failure situations. In addition, with unprecedented amounts of storage data crossing extension connections and consuming larger, faster links, Brocade enhanced Adaptive Rate Limiting reacts 10 times faster to varying traffic patterns that compete for WAN bandwidth or use shared interfaces.

The Brocade 7840 leverages the core technology of Brocade Gen 5 Fibre Channel platforms, consistently delivering 99.9999% uptime in the world's most demanding data centers. It combines enterprise-class availability with innovative features and the industry's only WAN-side, non-disruptive firmware upgrades to achieve always-on business operations and maximize application uptime. These capabilities enable a high-performance and highly reliable network infrastructure for disaster recovery and data protection.

Enhancing IP Storage Replication Local Performance over Long Distances

IP storage arrays with native replication applications are not built to handle latency and packet loss. The Brocade 7840 provides a robust IP extension solution that delivers local performance at long distance—along with strong encryption—for comprehensive disaster recovery. It leverages Brocade TCP Acceleration to help achieve the fastest replication speeds possible from IP storage devices, and Brocade WAN-optimized TCP to ensure in-order lossless transmission of IP extension data.

Brocade IP extension solutions help to significantly increase the performance of IP storage applications across the WAN—even with encryption turned on. The more latency and packet loss between the data centers, the greater the gain. The Brocade 7840 can move 50 times more data than native TCP/IP stacks to meet rigorous recovery objectives. Such performance gains enable use cases that at one time were deemed unfeasible.

IP extension also offers other, more far-reaching benefits. The Brocade 7840 supports and manages Fibre Channel/FICON and IP-based data flows, enabling storage administrators to consolidate I/O flows from heterogeneous devices and multiple protocols. The consolidation of these applications into a single, managed tunnel between data centers across the WAN has real operational, availability, security, and performance value.

Consolidating IP storage flows, or both IP storage and Fibre Channel/FICON flows, into a single tunnel contributes significantly to operational excellence. Operational advantages are gained with Fabric Vision, MAPS (Monitoring Alerting Policy Suite), WAN Test Tool (Wtool), and Brocade SAN management software. Using custom, browser-accessible dashboards for IP storage or combined Fibre Channel and IP

storage, storage administrators have a centralized management tool to monitor the health and performance of their networks.

IP extension supports a range of commonly used storage applications, such as array native IP Remote Data Replication (RDR), IP-based centralized backup, VM replication, host-based and database replication over IP, NAS head replication between data centers, and data migration between data centers.

Simplified Management and Robust Network Analytics

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. The Brocade 7840 Extension Switch supports the following Fabric Vision technology features for storage extension management:

- Monitoring and Alerting Policy Suite (MAPS): Provides a prebuilt, policy-based threshold monitoring and alerting tool that proactively monitors storage extension network health based on a comprehensive set of metrics at tunnel, circuit, and QoS (tunnel and circuit) layers. Administrators can configure multiple fabrics at one time using predefined or customized rules and policies for specific ports or switch elements.
- Fabric Performance Impact (FPI) Monitoring: Uses predefined thresholds and alerts in conjunction with MAPS to automatically detect and alert administrators to severe levels or transient spikes of latency, and to identify slow drain devices that could impact network performance. This feature uses advanced monitoring capabilities and intuitive MAPS dashboard reporting to indicate various latency severity levels, pinpointing exactly which devices are causing or are impacted by a bottlenecked port. This feature also provides automatic mitigation or recovery from the effects of slow drain devices.
- Dashboards: Provides integrated dashboards that display overall SAN and IP extension health, along with details on out-of-range conditions, and configuration drift to easily identify trends and quickly pinpoint issues occurring on a switch or in a fabric.
- Configuration and Operational Monitoring Policy Automation Services Suite (COMPASS): Simplifies deployment, safeguards consistency, and increases operational efficiencies of larger environments with automated switch and fabric configuration services. Administrators can configure a template or adopt an existing configuration as a template and seamlessly scale the configuration across the fabric. In addition, they can ensure settings do not drift over time with COMPASS configuration and policy violation monitoring within Brocade SAN management software dashboards.
- Brocade ClearLink® Diagnostics: Ensures optical and signal integrity for Fibre Channel optics and cables, simplifying deployment and support of high-performance fabrics. ClearLink Diagnostic Port (D_Port) is an advanced capability of Fibre Channel platforms.
- Flow Vision: Enables administrators to identify, monitor, and analyze specific application flows in order to simplify troubleshooting, maximize performance, avoid congestion, and optimize resources. Flow Vision includes:
  - Flow Learning: Enables administrators to non-disruptively discover all flows that go to or come from a specific host port or a storage port, or traverse Inter-Switch Links (ISLs), Inter-Fabric Links (IFLs), or Fibre Channel over Internet Protocol (FCIP) tunnels to monitor fabric-wide application performance. In addition, administrators can discover top and bottom bandwidth-consuming devices and manage capacity planning.
  - Flow Monitor: Provides comprehensive visibility into flows across a storage extension network, including the ability to automatically learn flows and non-disruptively monitor flow performance. Administrators can monitor all flows from a specific storage device that are writing to or reading from a destination storage device or logical unit numbers (LUNs), or across a storage extension network. Additionally, they can perform LUN-level monitoring of specific frame types to identify resource contention or congestion that is impacting application performance.
  - Flow Generator: Provides a built-in traffic generator for pretesting and validating storage extension infrastructure—including route verification, QoS zone setup, Extension Trunking

configuration, WAN access, IPsec policy setting, and integrity of optics, cables, and ports—for robustness before deploying applications.

- Forward Error Correction (FEC): Enables recovery from bit errors in ISLs, enhancing transmission reliability and performance.
- Credit Loss Recovery: Helps overcome performance degradation and congestion due to buffer credit loss.

Brocade SANnav™: Next-Generation SAN Management

Brocade SANnav™ Management Portal and SANnav Global View empower IT administrators by providing comprehensive visibility across the entire SAN, from a global view down to local environments. These tools streamline management workflows to accelerate the deployment of new applications, switches, hosts, and targets. They also increase operational efficiencies with a modernized graphical user interface (GUI) that enables enhanced monitoring, faster troubleshooting, and advanced analytics. SANnav Management Portal contextualizes data into visual dashboards, enabling administrators to quickly detect and isolate points of interest for both troubleshooting and performance optimization.

Integrated Architecture and Management

The Brocade 7840 utilizes the same Brocade Fabric OS® (FOS) that supports the entire Brocade Fibre Channel product family of switches and directors, as well as Brocade Extension platforms, including the Brocade 7810 switch and the Brocade SX6 blade. This helps ensure seamless interoperability with advanced features in Brocade FOS version releases, such as Brocade Integrated Routing, FICON Management Service (FMS), Brocade Extension Trunking, and Brocade Fabric Vision technology.

In addition, organizations can perform management and administrative tasks through familiar Brocade management tools, including Brocade SANnav Management Portal and SANnav Global View, Brocade Network Advisor, Brocade Web Tools, Brocade SAN Health® utility tool, and Command Line Interface (CLI). Moreover, optional FICON Control Unit Port (CUP) capabilities enable legacy management applications to seamlessly support Brocade FICON environments.

Brocade Global Support

Brocade Global Support has the expertise to help organizations build resilient, efficient SAN infrastructures. Leveraging 20+ 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.

Improve Efficiency with Fabric Automation

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 more than 20 years of storage networking experience, Brocade, a Broadcom company, understands the nuances that go into infrastructure management and the tasks that can benefit from automation. By introducing REST APIs directly into its switch and management products, Broadcom offers a broad range of choices to enable any SAN management solution. IT organizations that couple Broadcom's robust data collecting capabilities with automation and orchestration tools (such as Ansible) gain the ability to automate configuration tasks and the visibility to monitor and detect any performance or health changes.

Brocade automation solutions are based on these pillars:

- Make standard REST APIs available directly from the switch in order to automate repetitive daily tasks, such as fabric inventory, provisioning, and operational state monitoring.
- Leverage Ansible to easily scale automation and orchestration across the entire infrastructure.

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 www.broadcom.com/brocade

For information about supported SAN standards, visit www.broadcom.com/sanstandards

For information about switch and device compatibility, visit www.broadcom.com/compatibility

Brocade 7840 Extension Switch Specifications

System Architecture	
Enclosure	2U chassis designed to be mounted in a 19-in. cabinet
Fibre Channel ports	24 ports, 16 Gb/s, universal (E, F, M, D, and EX ports)
Ethernet ports	16 ports of 1GbE/10GbE for LAN and WAN connectivity 2 ports of 40GbE for WAN connectivity
Scalability	Full fabric architecture with 239 switches maximum
Certified maximum	Single fabric: 56 domains, 7 hops Multiprotocol routing fabric: 19 hops
Fibre Channel performance	2.125 Gb/s line speed, full duplex; 4.25 Gb/s line speed, full duplex; 8.5 Gb/s line speed, full duplex; 14.025 Gb/s line speed, full duplex; auto-sensing of 2, 4, 8, and 16 Gb/s port speeds
Ethernet interfaces	1GbE, 10GbE, and 40GbE
Brocade Trunking	Up to eight 16 Gb/s ports per Brocade Trunk; up to 128 Gb/s per trunk. There is no limit to how many trunk groups can be configured in the switch.
Fabric latency	700 ns with no contention, cut-through routing at 16 Gb/s
Maximum Fibre Channel frame size	2,112-byte payload
Maximum IP MTU size	Jumbo Frames at 9216 bytes
Classes of service	Class 2, Class 3, Class F (inter-switch frames)
Port types	F_Port, E_Port, EX_Port, (FCR E_Port), D_Port (Diagnostic), M_Port (Mirror), and self-discovery based on switch type (U_Port); VE_Port (FCIP and IP)
Data traffic types	Fabric switches supporting unicast, multicast (255 groups), and broadcast
USB	One USB port for system log file downloads or firmware upgrades
Media types	Fibre Channel: Brocade hot-pluggable Small Form Factor (SFP) and SFP+, short wavelength (SWL), long wavelength (LWL), and extended long wavelength (ELWL) transceivers (available wavelength options vary for 8 Gb/s and 16 Gb/s SFPs) Ethernet: Brocade hot-pluggable Small Form Factor (SFP) and SFP+, short reach wavelength (SRWL), long reach wavelength (LRWL), extended long wavelength (ELWL), and copper SFP/SFP+ transceivers (available reach options vary from 1GbE, 10GbE, and 40GbE)
Fabric services	Simple Name Server (SNS); Registered State Change Notification (RSCN), NTP, RADIUS, RCS (Reliable Commit Service), Dynamic Path Selection (DPS), Exchange-based routing, device-based routing, port-based routing, lossless), Brocade Advanced Zoning, Web Tools, Brocade Trunking, Extended Fabrics, Fabric Vision, SDDQ Optional Fabric services include: Integrated Routing (FCR), FICON CUP, FICON Management Server (FMS), and Advanced Accelerator for FICON.
Extension	Extension Trunking, Adaptive Rate Limiting (ARL), WAN Test Tool (Wtool), Open Systems Tape Pipelining (OSTP), FastWrite (FCIP-FW), QoS Marking, Bandwidth Enforcement, PerPriority TCP QoS, (PTQ), Adaptive Networking with QoS, and Advanced Extension and Integrated Routing (FCR)
Licensing options	The following optional extension features can be enabled via license keys: • Brocade 7840 WAN Rate Upgrade License 1 and 2: Enables additional WAN-side throughput to 10 Gb/s and unlimited with enablement of 40GbE ports • FICON Management Server (FMS): Control Unit Port (CUP) enables host control of switches in mainframe environments • Advanced Accelerator for FICON: Accelerates IBM zGM (XRC), FICON tape read/writes, and z/OS host connection to Teradata systems
Management	
Supported management software	SSH v2, HTTP/HTTPS, SNMP v1/v3, Telnet; SNMP (FE MIB, FC Management MIB); Brocade Web Tools; Brocade SANnav Management Portal and SANnav Global View, Brocade Network Advisor SAN Enterprise or Brocade Network Advisor Professional/Professional Plus (optional); Command Line Interface (CLI); SMI-S RADIUS, LDAP
Security	AES-GCM-256 encryption on FC ISLs (E_Port), AES-GCM-256 IPsec encryption on virtual ISLs (VE_Port), DH-CHAP (between switches and end devices), FCAP switch authentication; FIPS 140-2 L2-compliant, HTTPS, IP filtering, LDAP with IPv6, OpenLDAP, Port Binding, RADIUS, TACACS+, User-defined Role-Based Access Control (RBAC), Secure Copy (SCP), Secure RPC, SFTP, SSH v2, SSL, Switch Binding, Trusted Switch
Management access	10/100/1000 Ethernet (RJ-45); serial port (RJ-45) and one USB port
Diagnostics	POST and embedded online/offline diagnostics, including D_Port, FCIP ping, FCIP traceroute, FCping, Pathinfo (FCtraceroute), Wtool, and Ftrace

Brocade 7840 Extension Switch Specifications (cont.)

Mechanical	
Enclosure	Back-to-front airflow; 2U, 19-in. EIA-compliant, power from back
Size	Width: 44 cm (17.32 in.) Height: 8.64 cm (3.4 in.) Depth: 60.9 cm (24.0 in.)
System weight	20 kg (44.2 lb) with two power supplies, without SFP/SFP+
Environment	
Temperature	Operating: 0°C to 40°C (32°F to 104°F) Non-operating: –25°C to 70°C (–13°F to 158°F)
Humidity	Operating: 10% to 85% (non-condensing) Non-operating: 10% to 90% (non-condensing)
Altitude	Operating: Up to 3000m (9842 ft) Storage: Up to 12 km (39,370 ft)
Shock	Operating: 20g, 11 ms, half-sine Non-operating: 33g, 11 ms, half-sine, 3/eg Axis
Vibration	Operating: 1.0g sine, 0.5 grms random, 5 Hz to 500 Hz Non-operating: 2.4g sine, 1.1 grms random 5 Hz to 500 Hz
Airflow	Maximum: 158 CFM
Power	
Power supply	Dual hot-swappable redundant power supplies
Power inlet	C14; requires C13 plug
Input voltage	90 VAC to 264 VAC nominal
Input line frequency	47 Hz to 63 Hz nominal
Inrush current	Maximum of 40 amps for period of 10 ms to 150 ms
Power consumption	Short-range optics: Nominal 388 watts/1324 BTU/hr; maximum 454 watts/1550 BTU/hr Long-range optics: Nominal 426 watts/1454 BTU/hr; maximum 492 watts/1679 BTU/hr

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