IBM System Storage SAN42B-R Extension Switch

IBM Redbooks Product Guide

This IBM® Redbooks® Product Guide describes the IBM System Storage® SAN42B-R extension switch.

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

The System Storage SAN42B-R Extension Switch 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 wide area network (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 SAN42B-R addresses the most demanding disaster recovery requirements. Twenty-four 16 gigabits per second (Gbps) Fibre Channel/IBM Fibre Channel connection (IBM FICON®) ports, sixteen 1/10 Gigabit Ethernet (GbE) ports, and two 40 GbE ports provide the bandwidth, port density, and throughput required for maximum application performance over WAN connections.

The SAN42B-R provides scalable deployment options to extend disaster recovery and data protection storage solutions across any distance. It includes a suite of features that help ensure continuous availability of a storage extension network, from pre-deployment validation tools to advanced network failure recovery technologies, including the following examples:

- Built-in tools help validate the setup of WAN links, network paths, Fibre Channel over IP (FCIP), and IP Extension (IPEX) configurations before deployment.
- The Extension Trunking feature protects against WAN link failures, with tunnel redundancy for lossless path failover, and guaranteed in-order data delivery. This advanced trunking feature allows multiple network paths to be used simultaneously. When there is a network path failure, extension trunking retransmits the lost packets and maintains data integrity without disruption.
- Adaptive Rate Limiting optimizes bandwidth use and maintains full WAN performance of the link when a path is offline due to a platform, IP network device, or array controller outage. It uses dynamic bandwidth sharing between minimum and maximum rate limits to achieve continuous availability. With unprecedented amounts of storage data crossing extension connections and using bigger, faster links, it can react 10 times faster to varying traffic patterns that compete for WAN bandwidth or use shared interfaces.

By using the core technology of Gen 5 Fibre Channel platforms, the SAN42B-R extension switch combines enterprise-class availability with innovative features and non-disruptive firmware upgrades. This combination supports always-on business operations, and maximizes application uptime. These capabilities enable a high-performance and highly reliable network infrastructure for disaster recovery and data protection.

Figure 1 shows the SAN42B-R extension switch.

Figure 1. The IBM System Storage SAN42B-R extension switch

Did you know?

You can use the SAN42B-R extension switch in several ways to protect data and meet performance requirements:

- Move more storage data between data centers to meet increasing disaster recovery and business continuity objectives, with industry-leading performance and scalability.
- Encrypt storage data flows over long distances without sacrificing performance.
- Improve load balancing and network resilience with extension trunking, which increases WAN use and helps protect against WAN link failures.

Product highlights

IT organizations continue to face the unrelenting growth of data being transferred between data centers, while service level agreement (SLA) and recovery expectations continue to rise. Meanwhile, enterprise data centers must also keep pace with the changes driven by virtual application workloads. Many organizations are modernizing their disaster recovery plans to help ensure continuous availability of their IT systems. The storage network infrastructure must continue to evolve to enable fast, continuous, and simple access to mission-critical data from anywhere in the world.

The IBM System Storage SAN42B-R extension switch delivers the excellent performance, continuous availability of a storage extension network, and powerful network and application monitoring that organizations need to handle escalating data traffic. It includes both b-type Fabric Vision and Gen 5 Fibre Channel technology, which is the purpose-built, proven storage networking infrastructure for delivering outstanding reliability, simplicity, and 16 Gbps performance. The SAN42B-R extension switch helps storage administrators replicate and back up large amounts of data over a WAN quickly, reliably, and simply, while minimizing operational and capital expenses.

Using the SAN42B-R extension switch offers several key advantages:

- 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 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

Architecture and key components

This section describes the architecture and key components of the System Storage SAN42B-R switch.

A purpose-built, scalable, and flexible extension platform

The SAN42B-R switch provides an ideal platform for building a high-performance data center extension infrastructure for replication and backup solutions. It leverages cost-effective IP WAN transports to extend open systems and mainframe disk storage applications over distances that would otherwise be impossible, impractical, or too expensive with standard Fibre Channel connections.

Figure 2 shows two typical use cases:
- Synchronous and asynchronous replication
- Centralized backup and archiving

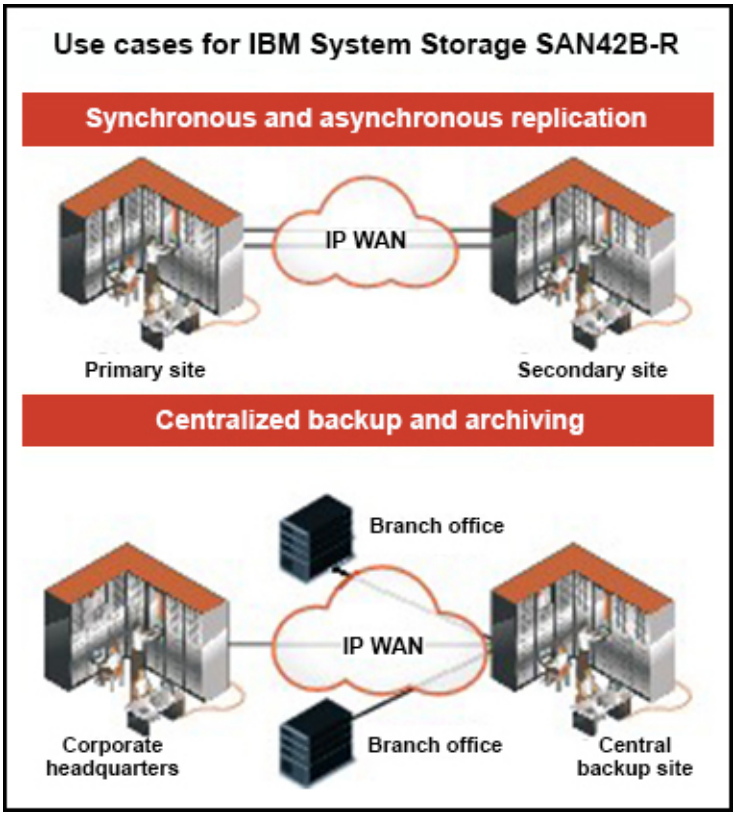

Figure 2. Use case workflow diagrams

Continuous availability between data centers

The SAN42B-R extension switch addresses the most demanding disaster recovery requirements. Twenty-four 16 Gbps Fibre Channel ports, sixteen 1/10 Gigabit Ethernet (GbE) ports, and two 40 GbE ports provide the bandwidth, port density, and throughput required to help maximize application performance over WAN links.

Because it is designed for maximum flexibility, this enterprise-class extension switch offers “pay-as-you-grow” scalability with capacity-on-demand upgrades. Organizations can quickly and cost-effectively scale WAN rates from 5 Gbps to 40 Gbps per platform by upgrading software licenses to meet current and future requirements.

The base configuration includes a comprehensive set of advanced services:

- Fabric Vision technology
- Trunking and extension trunking
- Adaptive Rate Limiting
- Internet Protocol Security (IPSec)
- Compression
- Extended fabric

Optional licenses for Integrated Routing, IBM FICON Control Unit Port (CUP), and Advanced FICON Accelerator are available to help address a variety of storage networking challenges.

Built for large-scale, multisite data center environments, the SAN42B-R extension switch is ideal for data protection for open systems and mainframes, and for multisite synchronous and asynchronous storage replication.

Moving more data through industry leading performance and scalability

The SAN42B-R addresses today’s dynamic input/output (I/O) and workload requirements, and meets the evolving requirements of highly virtualized data centers. Because it supports up to 250 milliseconds (ms) round-trip time (RTT) for latency, it enables cost-effective extension solutions over distances up to 37,500 kilometers (23,400 miles). It helps maximize replication and backup throughput over long distances by using data compression, disk protocol acceleration, and Fibre Channel over IP (FCIP) networking technology. It also includes the following advanced features and technologies:

- Extension Trunking: Combines multiple WAN connections into a single logical high-bandwidth trunk that provides active load balancing and network resilience to protect against WAN link failures.
- IPSec: Ensures secure transport over WAN links by encrypting data in flight with a standard 256-bit Advanced Encryption Standard (AES) algorithm without a performance penalty.
- Extremely efficient architecture: Permits the high-speed, low-latency processing of frames, which makes extension of synchronous applications possible.
- Adaptive Rate Limiting: Dynamically adjusts bandwidth sharing between minimum and maximum rate limits to optimize bandwidth use and maintain WAN performance during disruptions.
- Advanced compression architecture: Provides multiple modes to optimize compression ratios for various throughput requirements.
- WAN-Optimized TCP: An aggressive Transmission Control Protocol (TCP) stack that optimizes TCP window size and flow control, which accelerates TCP transport for high-throughput storage applications.
- Priority TCP Quality of Service (PTQ): Handles high, medium, and low-priority initiator target flows within the same tunnel for transmission over the WAN, with individual TCP sessions per quality of service (QoS) class.
- FCIP Fast Write: Accelerates Small Computer System Interface (SCSI) write processing to maximize performance of synchronous and asynchronous replication applications across high-latency WAN connections over any distance.
- Advanced Accelerator for FICON: Uses advanced networking technologies, data management techniques, and protocol intelligence to accelerate IBM z/OS® Global Mirror (zGM), mainframe tape read and write operations, and z/OS host connection to Teradata warehousing systems over long distance.

Enhancing IP storage replication local performance over long distance

IP storage arrays with native replication applications are not built to handle latency and packet loss. The SAN42B-R provides a robust IP extension solution that delivers local performance at long distance (along with strong encryption) for comprehensive disaster recovery and backup solutions.

It leverages TCP Acceleration to help achieve the fastest replication speeds possible from IP storage devices, and b-type WAN-optimized TCP to ensure in-order lossless transmission of IP extension data. The SAN42B-R IP extension technology helps 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 SAN42B-R 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 SAN42B-R 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, Monitoring Alerting Policy Suite (MAPS), WAN Test Tool (Wtool), and IBM Network Advisor. 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 IBM TS7700 Grid, array native IP Remote Data Replication (RDR), IP-based centralized backup, virtual machine (VM) replication, host-based and database replication over IP, network-attached storage (NAS) head replication between data centers, and data migration between data centers.

Integrated architecture and management

The SAN42B-R uses the same Fabric Operating System (FOS) that supports the entire IBM System Storage b-type Fibre Channel family of products. This helps ensure continuous interoperability with advanced features, such as Fabric OS version releases, Integrated Routing, FICON Management Service (FMS), Extension Trunking, Fabric Vision technology, and Extended Fabrics.

In addition, organizations can perform management and administrative tasks through familiar management tools, including IBM Network Advisor, web tools, the storage area network (SAN) Health utility, and the command-line interface (CLI). Optional FICON Control Unit Port capabilities enable legacy management applications to support IBM FICON environments.

Fabric Vision technology extends between data centers

Fabric Vision technology, an extension of Gen 5 Fibre Channel, provides outstanding insight and visibility across the storage network. Its powerful built-in monitoring, management, and diagnostic tools enable organizations to achieve important objectives. It simplifies monitoring, maximizes network availability, and dramatically reduces costs:

- Simplify monitoring:
  - Deploy 20 years of preferred practices in one click to simplify the deployment of monitoring with predefined, threshold-based rules, actions, and policies.
  - Instantly identify latency and congestion issues in the fabric through increased instrumentation and granularity.
  - Gain comprehensive visibility into the network health and performance by using browser-accessible dashboards with drill-down capabilities.
- Increase availability:
  - Extend proactive monitoring between data centers to automatically detect WAN anomalies, to address problems before they affect operations.
  - Identify hot spots and network problems through intuitive reports and trend analysis before they have an effect on application performance.
  - Minimize downtime and accelerate troubleshooting with monitoring, integrated diagnostics, and point-in-time playback.
- Dramatically reduce costs:
  - Eliminate nearly 50 percent of maintenance costs through automated testing and diagnostic tools that validate the health, reliability, and performance of the network before deployment.
  - Save up to millions of dollars in capital expenses by eliminating the need for expensive third-party tools, by using built-in monitoring and diagnostics.
  - Leverage specialized tools for pretesting and validating your IT infrastructure to accelerate deployment, simplify support, and reduce operational costs.

Simplified management and robust network analytics

Featuring innovative monitoring, management, and diagnostic capabilities, Fabric Vision technology helps administrators avoid problems before they affect operations — and their SLAs. The SAN42B-R extension switch supports the following Fabric Vision technology features:

- Monitoring and Alerting Policy Suite (MAPS):

  Provides a pre-built, policy-based threshold monitoring and alerting tool that simplifies fabric-wide threshold configuration and actions. Administrators can configure multiple fabrics at one time by using predefined or customized rules and policies for specific ports or switch elements.
- Fabric Performance Impact monitoring:

  Uses predefined thresholds and alerts in conjunction with MAPS to automatically detect and alert administrators to severe levels of latency. It also identifies slow-drain devices that might affect the network. This feature uses advanced monitoring capabilities and intuitive MAPS dashboard reports to indicate various latency severity levels, so it pinpoints exactly which devices are causing or affected by a port bottleneck.
- Dashboards:

  Integrates dashboards that display an overall SAN health view, along with details on out-of-range conditions. This helps administrators easily identify trends and quickly spot issues that are occurring on a switch or in a fabric.

- ClearLink diagnostics:

  Ensures optical and signal integrity for Gen 5 Fibre Channel optics and cables, which simplifies deployment and support of high-performance fabrics. The ClearLink Diagnostic Port (D_Port) is an advanced capability of Gen 5 Fibre Channel platforms.

- Flow Vision:

  Enables administrators to identify, monitor, and analyze specific application flows so that they can simplify troubleshooting, maximize performance, avoid congestion, and optimize resources. Flow Vision includes the following components:

  - Flow Monitor:

    Provides comprehensive visibility of flows within the fabric, including the ability to automatically learn flows and nondisruptively monitor flow performance. Administrators can monitor all flows from a specific host to multiple targets or storage logical unit numbers (LUNs), from multiple hosts to a specific target or LUN, or across a specific inter-switch link (ISL). They can also perform LUN-level monitoring of specific frame types to identify resource contention or congestion that is affecting application performance.

  - Flow Generator:

    A built-in traffic generator for pre-testing and validating the data center infrastructure (including route verification and integrity of optics, cables, ports, back-end connections, and ISLs) for robustness before deploying applications.

- Forward Error Correction:

  Enables recovery from bit errors in ISLs, which enhances transmission reliability and performance.

- Credit loss recovery:

  Helps overcome performance degradation and congestion that results from buffer credit loss.

The IBM Network Advisor software management tool simplifies Gen 5 Fibre Channel management and helps users proactively diagnose and resolve issues to maximize uptime, increase operational efficiency, and reduce costs. The wizard-driven interface dramatically reduces deployment and configuration times by enabling fabrics, switches, and ports to be managed as groups. Customizable dashboards graphically display performance and health indicators, including all data that is captured by using Fabric Vision technology. To accelerate troubleshooting, administrators can use dashboard playback to quickly review past events and identify problems in the fabric. Dashboards and reports can be configured to show only the most relevant data, so that administrators can more efficiently prioritize their actions and maintain network performance.

Specifications

This section describes the product specifications for the System Storage SAN42B-R extension switch.

System architecture

Table 1 lists system architecture specification details.

Table 1. System architecture specifications for the SAN42B-R extension switch (Part 1 of 3)

Feature	Description
Enclosure	2U chassis designed to be mounted in a 19-in. cabinet
Fibre Channel ports	24 ports, 16 Gbps, universal (E, F, M, D, and EX ports)
Ethernet ports	16 ports of 1/10 GbE and 2 ports of 40 GbE (VE)

Table 1. System architecture specifications for the SAN42B-R extension switch (Part 2 of 3)

Feature	Description
Scalability	Full fabric architecture with 254 switches, maximum
Certified maximum	Single fabric: 56 domains, 7 hops Multiprotocol routing fabric: 19 hops
Fibre Channel performance	Auto-sensing of 2, 4, 8, and 16 Gbps port speeds
FCIP Ethernet interfaces	1 GbE, 10 GbE, and 40 GbE
b-type trunking	Up to eight 16 Gbps ports per b-type trunk; up to 128 Gbps per trunk. There is no limit to how many trunk groups can be configured in the switch.
Fabric latency	700 nanoseconds (ns) with no contention, cut-through routing at 16 Gbps
Maximum frame size	2112-byte payload
Maximum maximum transmission unit (MTU) size	Ethernet Jumbo Frames at 9,000-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 virtual E Port).
Data traffic types	Fabric switches supporting unicast, multicast (255 groups), and broadcast
Universal Serial Bus (USB)	One USB port for system log file downloads or firmware upgrades
Media types	Fibre Channel: ● b-type hot-pluggable small form factor (SFP) and SFP+ ● Short wavelength (SWL), long wavelength (LWL) ● Extended long wavelength (ELWL) transceivers (available wavelength options vary for 8 Gbps and 16 Gbps SFPs) Ethernet: ● b-type hot-pluggable SFP and SFP+ ● Short reach wavelength (SRWL) ● Long reach wavelength (LRWL) ● Extended long wavelength (ELWL) ● Copper SFP and SFP+ transceivers (available reach options vary: 1 GbE, 10 GbE, and 40 GbE)
Fabric services	Fabric services: ● Simple Name Server (SNS) ● Registered state change notification (RSCN) ● Network Time Protocol (NTP), remote authentication dial-in user service (RADIUS), Reliable Commit Service (RCS) ● Dynamic Path Selection (DPS) ● Exchange-based routing ● Device-based routing ● Port-based routing, lossless ● Advanced zoning ● Web tools ● Adaptive Networking with QoS ● Extended fabric, ISL trunking ● Fabric Vision technology ● Advanced Extension

Table 1. System architecture specifications for the SAN42B-R extension switch (Part 3 of 3)

Feature	Description
Fabric services (continued)	Optional fabric services: ● Fibre Channel routing (FCR) ● FICON CUP ● FICON Management Server (FMS) ● Advanced Accelerator for FICON
Licensing options	The following optional extension features can be enabled by license keys: ● Local area network (LAN) Rate Upgrade License 1 and 2, which enables additional WAN throughput at 10 Gbps level and unlimited level (up to system maximum of 40 Gbps) ● FICON Management Server, where the Control Unit Port (CUP) enables host control of switches in mainframe environments. ● Advanced Accelerator for FICON, which accelerates IBM Global Mirror data replication and z/OS host connection to Teradata systems

Management

Table 2 lists the management features.

Table 2. Management features of the SAN42B-R extension switch (Part 1 of 2)

Feature	Description
Supported management software	● Secure Shell (SSH2) ● Hypertext Transfer Protocol (HTTP, HTTPS) ● Simple Network Management Protocol (SNMP V1, V3) ● Telnet ● SNMP (FE Management Information Base (MIB), FC Management MIB) ● Web tools ● IBM Network Advisor Enterprise or IBM Network Advisor Professional Plus (optional) ● Command-line interface (CLI) ● SMI-S RADIUS ● Lightweight Directory Access Protocol (LDAP)
Security	● AES-GCM-256 IPsec encryption on ISLs ● 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), in-band over Fibre Channel ports ● Serial port (RJ-45) and one USB port

Table 2. Management features of the SAN42B-R extension switch (Part 2 of 2)

Feature	Description
Diagnostics	POST and embedded online or offline diagnostics, including the following tools: ● D_Port ● FCIP ping ● FCIP traceroute ● FCping ● Pathinfo (FCtraceroute) ● wtool ● Ftrace

Physical and environmental specifications

Table 3 lists the physical and environmental specifications.

Table 3. Physical and environmental specifications for the SAN42B-R extension switch

Feature	Description
Mechanical enclosure	Back-to-front airflow, 2U, 19-in. EIA-compliant, power from back
Size	Width: 44 cm (17.3 in.) Height: 8.6 cm (3.2 in.) Depth: 60.9 cm (24.01 in.)
System weight	19 kg (42.0 lb) with two power supplies, without SFP or SFP+
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 3,000 m (9,842 ft.) Storage: Up to 12 km (39,370 ft.)
Shock	Operating: 20 g, 11 ms, half-sine Non-operating: 33 g, 11 ms, half-sine, 3/eg axis
Vibration	Operating: 1.0 g sine, 0.5 grms random, 5 to 500 Hz Non-operating: 2.4 g sine, 1.1 grms random 5 to 500 Hz
Heat dissipation	Maximum: 478 BTU/hr
Power supply	Dual hot-swappable redundant power supplies
Power inlet	C14, which requires a C13 plug
Input voltage	90 to 264 V ac nominal
Input line frequency	47 to 63 Hz nominal
Power	Short-range optics: Nominal 388 watts/1,324 BTU/hr; maximum 454 watts/1,550 BTU/hr Long-range optics: Nominal 426 watts/1,454 BTU/hr; maximum 492 watts/1,679 BTU/hr

Why IBM

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Related publications

For more information about the SAN42B-R extension switch, see the following web pages:

- IBM System Storage SAN42B-R Extension Switch
  http://www.ibm.com/systems/storage/san/b-type/san42b-r/
- Distance challenges of native array IP replication solutions
  http://www.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=TSW03372USEN
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