



Cisco MDS 9710 Multilayer Director for IBM System Networking

IBM Redbooks Product Guide

This IBM® Redbooks® Product Guide introduces Cisco MDS 9710 Multilayer Director for IBM System Networking (9710-E08). It is a director-class storage area network (SAN) switch that is designed for deployment in large-scale storage networks to enable enterprise clouds and business transformation by adding enterprise connectivity options that support IBM Fibre Connection (IBM FICON®) connectivity.

MDS 9710 delivers a high performing and reliable FICON infrastructure that is designed to support fast and scalable IBM z Systems™ servers.

With the Cisco MDS 9700 48-Port 10-Gbps Fibre Channel over Ethernet (FCoE) Module and the Cisco MDS 9700 24-port 40-Gbps FCoE Module, the MDS 9700 platforms provide multiprotocol flexibility for SANs that delivers 16 Gbps FC and 10/40 Gbps FCoE capability and 1/10 FCIP capabilities.

Layering a comprehensive set of intelligent features onto a high-performance, protocol-independent switch fabric, the MDS 9710 addresses the stringent requirements of large virtualized data center storage environments: High availability, security, scalability, ease of management, and transparent integration of new technologies for flexible data center SAN solutions. Sharing the operating system and management interface with other Cisco data center switches, the MDS 9710 enables seamless deployment of fabrics with high-performance Fibre Channel, IBM FICON, FCoE, and Fibre Channel over IP (FCIP) connectivity to achieve low total cost of ownership (TCO).

For mission-critical enterprise storage networks that require secure, robust, cost-effective business-continuance services, the FCIP extension module is designed to deliver outstanding SAN extension performance, reducing latency for disk and tape operations with FCIP acceleration features, including FCIP write acceleration and FCIP tape write and read acceleration.

Figure 1 shows the Cisco MDS 9710 Multilayer Director for IBM System Networking.

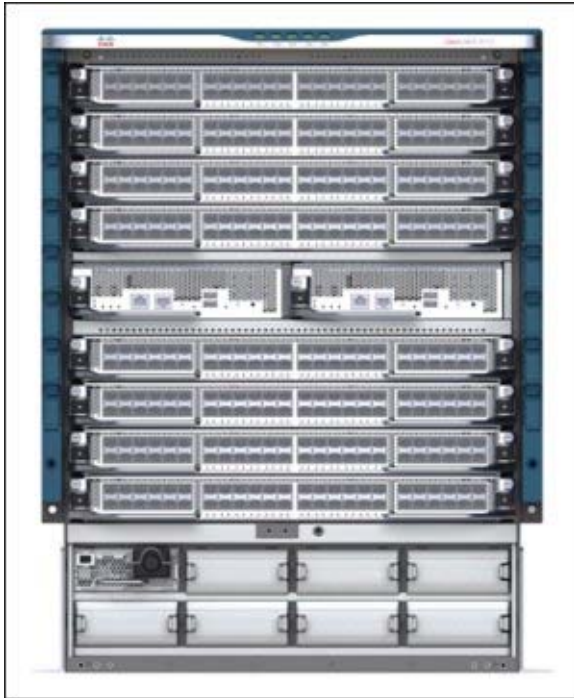


Figure 1. Cisco MDS 9710 Multilayer Director for IBM System Networking

Did you know?

- The MDS 9710 director class switch enables redundancy on all major components, including the fabric card.
- The MDS 9000 24/10-Port SAN Extension Module supports hardware-based FCIP compression to increase the effective WAN bandwidth of SAN extension solutions. The module can deliver compression ratios in the range of 4:1 - 5:1 over a wide variety of data sources.
- The MDS 9700 Series provides deterministic hardware performance and a comprehensive feature set that allows virtual machines to have the same SAN attributes as a physical server.
- The combination of the Supervisor-1, 32 Gbps Fibre Channel switching module, 16 Gbps Fibre Channel switching module, and Fabric-1 Crossbar switching modules enables up to 1.5 Tbps of FC throughput between modules for each of the eight MDS 9710 payload slots.

Product overview

The capabilities of the Cisco MDS 9710 can be extended with modules.

The Cisco MDS 9000 24/10-Port SAN Extension Module

The MDS 9000 24/10-Port SAN Extension Module is supported on Cisco MDS 9700 Series Multilayer Directors. With 24 line-rate 2-, 4-, 8-, 10-, and 16-Gbps Fibre Channel ports and eight 1 and 10 Gigabit Ethernet FCIP ports, this module enables large and scalable deployment of SAN extension solutions. The SAN extension module has two independent service engines that can each be individually and incrementally enabled to scale as business requirements expand.

The SAN extension module supports the full range of services available on other Cisco MDS 9000 Family Fibre Channel switching modules, including virtual SAN (VSAN), security, and traffic management services. The FCIP module uses Cisco expertise and knowledge of IP networks to deliver outstanding SAN extension performance, reducing latency for disk and tape operations with FCIP acceleration features, including FCIP write acceleration and FCIP tape write and read acceleration.

Hardware-based encryption helps secure sensitive traffic with IP Security (IPsec), and hardware-based compression dramatically enhances performance for both high- and low-speed links, enabling immediate cost savings in expensive WAN infrastructure. Multiple FCIP interfaces within a single engine or across service engines can be grouped into a port channel of up to 16 links for high availability and increased aggregate throughput.

Figure 2 shows the Cisco MDS 9000 24/10-Port SAN Extension Module.

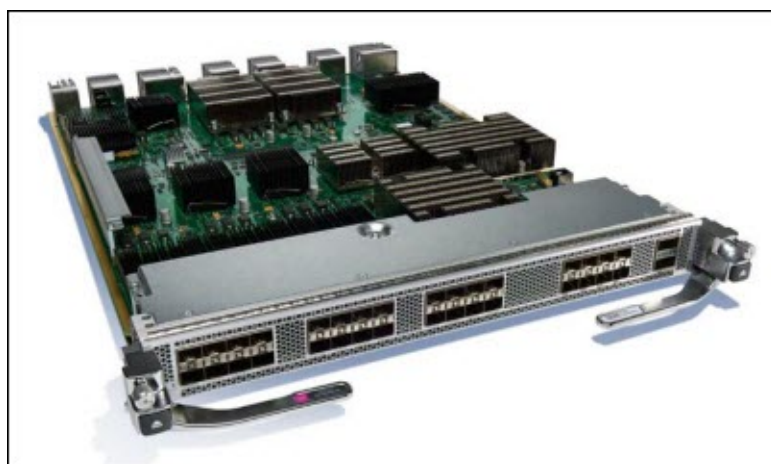


Figure 2. Cisco MDS 9000 24/10-Port SAN Extension Module

Main features and benefits

The MDS 9000 24/10-Port SAN Extension Module is designed for mission-critical enterprise storage networks that require secure, robust, cost-effective business-continuance services. The SAN extension module offers the following main features:

- **FCIP for remote SAN extension :**
 - Simplifies data-protection and business-continuance strategies by enabling backup, remote replication, and other disaster-recovery services over WAN distances using open standards FCIP tunneling.
 - Optimizes utilization of WAN resources for backup and replication by enabling hardware-based compression, hardware-based encryption, FCIP write acceleration, and tape read and write acceleration for both FCIP and FICON over IP. The SAN extension module will support four tunnels per interface and can scale up to 32 tunnels (four tunnels x eight 1/10GE ports).
 - Preserves MDS 9000 Family enhanced capabilities, including VSANs, advanced traffic management, and security, across remote connections.
- **Integrated IP storage services in a high -density form factor:** The module supports eight 1 and 10 Gigabit Ethernet ports. Individual ports can be configured with hot-swappable shortwave and longwave Small Form-factor Pluggable (SFP) connections.

- **Integrated hardware-based VSANs and Inter-VSAN Routing (IVR):** The module enables deployment of large-scale multisite and heterogeneous SAN topologies. Integration into port-level hardware allows any port in a system or fabric to be partitioned into any VSAN. Integrated hardware-based IVR provides line-rate routing between any ports in a system or fabric without the need for external routing appliances.
- **Intelligent network services :** The module uses VSAN technology for hardware-enforced, isolated environments in a single physical fabric; access control lists (ACLs) for hardware-based intelligent frame processing; and advanced traffic management features, such as fabric-wide quality of service (QoS), to facilitate migration from SAN islands to enterprise wide storage networks.
- **Sophisticated diagnostics:** The module provides intelligent diagnostics, protocol decoding, and network analysis tools, in addition to integrated Cisco Call Home capability, for greater reliability, faster problem resolution, and reduced service costs.
- **Comprehensive network security framework :** The module supports RADIUS and TACACS+, Fibre Channel Security Protocol (FC-SP), Secure File Transfer Protocol (SFTP), Secure Shell (SSH) Protocol, Simple Network Management Protocol Version 3 (SNMPv3) implementing the Advanced Encryption Standard (AES), VSANs, hardware-enforced zoning, ACLs, and per-VSAN role-based access control (RBAC). RBAC provides separate control over management functions and access on a per-VSAN basis, enabling separation of duties among administrators on the same physical switch. Gigabit Ethernet ports support IPsec authentication, data integrity, and hardware-assisted data encryption.
- **IP Version 6 (IPv6) support:** The module supports IPv6 as mandated by the U.S. Department of Defense (DoD), Japan, and China. IPv6 support is provided for FCIP and for management traffic routed in band and out of band.

Integrated FCIP for remote SAN and mainframe channel extension

Data-distribution, data-protection, and business-continuance services are significant components of today's information-centered businesses. The capability to efficiently replicate critical data on a global scale helps ensure a higher level of data protection for valuable corporate information, and also increases utilization of backup resources and lowers total cost of storage ownership. The MDS 9000 24/10-Port SAN Extension Module uses the open-standards FCIP protocol to extend the distance of current Fibre Channel and FICON solutions, enabling interconnection of SAN islands over extended distances.

Advanced SAN extension features

The MDS 9000 24/10-Port SAN Extension Module supports hardware-based FCIP compression to increase the effective WAN bandwidth of SAN extension solutions. The module can deliver compression ratios in the range of 4:1 - 5:1 over a wide variety of data sources.

The SAN extension module supports AES 256 IPsec encryption for secure transmission of sensitive data over extended distances. Hardware enablement of IPsec helps ensure line-rate throughput. Together, hardware-based compression and hardware-based encryption provide a high-performance, highly secure SAN extension capability.

Additionally, the SAN extension module supports FCIP write acceleration, a feature that can significantly improve application performance when storage traffic is extended across long distances. When FCIP write acceleration is enabled, WAN throughput is optimized by reducing the latency of command acknowledgments.

VSANs

Well suited for efficient, secure SAN consolidation, ANSI T11-standard VSANs enable more efficient storage network utilization by creating hardware-based isolated environments with a single physical SAN fabric or switch. Each VSAN can be zoned as a typical SAN and maintained with its own fabric services for greater scalability and resilience. VSANs allow the cost of SAN infrastructure to be shared among more users, while helping ensure segregation of traffic and retaining independent control of configuration on a VSAN-by-VSAN basis.

Integrated SAN Routing

In another step toward deployment of efficient, cost-effective, consolidated storage networks, the MDS 9000 24/10-Port SAN Extension Module supports IVR, the industry's first and most efficient routing function for Fibre Channel. IVR allows selective transfer of data between specific initiators and targets on different VSANs while maintaining isolation of control traffic within each VSAN. With IVR, data can transit VSAN boundaries while maintaining control-plane isolation, thereby maintaining fabric stability and availability. IVR eliminates the need for external routing appliances, greatly increasing routing scalability while delivering line-rate routing performance, simplifying management, and eliminating the challenges associated with maintaining separate systems. IVR reduces the total cost of SAN ownership.

Advanced Traffic Management

The advanced traffic management capabilities integrated into the MDS 9000 24/10-Port SAN Extension Module simplify deployment and optimization of large-scale fabrics:

- **Virtual output queuing:** Helps ensure line-rate performance on each port, independent of traffic pattern, by eliminating head-of-line blocking.
- **Port channels:** Allow users to aggregate up to 16 FCIP ISLs into a single logical bundle, providing optimized bandwidth utilization across all links. The bundle can consist of any speed-matched ports from any module in the chassis, helping ensure that the bundle can remain active even in the event of a module failure.
- **Fabric Shortest Path First (FSPF)-based multipathing:** Provides the intelligence to load-balance traffic across up to 16 equal-cost paths and, in the event of a switch failure, dynamically reroute traffic.
- **QoS:** Can be used to manage bandwidth and control latency to prioritize critical traffic.
- **Shaper:** Rate limits the WAN bandwidth according to the maximum bandwidth configured for the FCIP tunnel.

Advanced diagnostics and troubleshooting tools

Management of large-scale storage networks requires proactive diagnostics, tools to verify connectivity and route latency, and mechanisms for capturing and analyzing traffic. The MDS 9000 Family integrates the industry's most advanced analysis and diagnostic tools. Power-on self-test (POST) and online diagnostics provide proactive health monitoring.

The MDS 9000 24/10-Port SAN Extension Module implements diagnostic capabilities, such as Fibre Channel Traceroute to detail the exact path and timing of flows, and Cisco Switched Port Analyzer (SPAN) to intelligently capture network traffic. The module also supports the SAN Extension Tuner (SET) tool, which helps you optimize FCIP performance by generating either direct-access (for magnetic disks) or sequential-access (for magnetic tape) Small Computer System Interface (SCSI) I/O commands and directing this traffic to a specific virtual target.

You can specify the size of the test I/O transfers and the number of concurrent or serial I/O operations to generate while testing. The SET tool reports the resulting I/O operations per second (IOPS) and I/O latency, which helps you determine the number of concurrent I/O operations needed to get the best FCIP throughput.

After traffic has been captured, it can be analyzed with the Cisco Fabric Analyzer, an embedded Fibre Channel analyzer. Comprehensive port-based and flow-based statistics facilitate sophisticated performance analysis and service-level agreement (SLA) accounting. With the MDS 9000 Family, Cisco delivers a comprehensive tool set for troubleshooting and analyzing storage networks.

Comprehensive solution for robust network security

Addressing the need for fail-proof security in storage networks, the MDS 9000 24/10-Port SAN Extension Module offers an extensive security framework to protect highly sensitive data moving in today's enterprise networks. The module employs intelligent frame inspection at the port level, including the application of ACLs for hardware enforcement of zones, VSANs, and advanced port security features:

- Extended zoning capabilities restrict broadcasts to only the selected zones (broadcast zones).
- VSANs are used to achieve greater security and stability by providing complete isolation among devices that are connected to the same physical SAN.
- FC-SP provides switch-to-switch and host-to-switch Diffie-Hellman Challenge Handshake Authentication Protocol (DH-CHAP) authentication supporting RADIUS and TACACS+, to help ensure that only authorized devices can access protected storage networks.

The Cisco MDS 9700 Series Supervisor-1 Module

The Cisco MDS 9700 Series Supervisor-1 Module delivers the latest advanced switching technology with Cisco NX-OS software to power a new generation of scalable and intelligent multilayer switching solutions for SANs.

Designed to integrate multiprotocol switching and routing, intelligent SAN services, and storage applications onto highly scalable SAN switching platforms, the MDS 9700 Series Supervisor-1 Module enables intelligent, resilient, scalable, and secure high performance multilayer SAN switching solutions when combined with the MDS 9700 switching modules.

The Cisco MDS 9000 Family lowers the TCO for storage networking by combining a robust and flexible hardware architecture, multiple layers of network and storage intelligence, and compatibility with all MDS 9000 Family switching modules. It offers advanced management tools for overall lowest TCO. It supports Cisco Systems VSAN technology for hardware-enforced, isolated environments within a single physical fabric for secure sharing of physical infrastructure, which further decreases TCO.

This powerful combination helps organizations to build highly available, scalable storage networks with comprehensive security and unified management. The MDS Supervisor-1 Module is supported in the MDS 9710 Multilayer Director.

Figure 3 shows the 16 Gbps Cisco MDS 9700 Series Supervisor-1 Module.

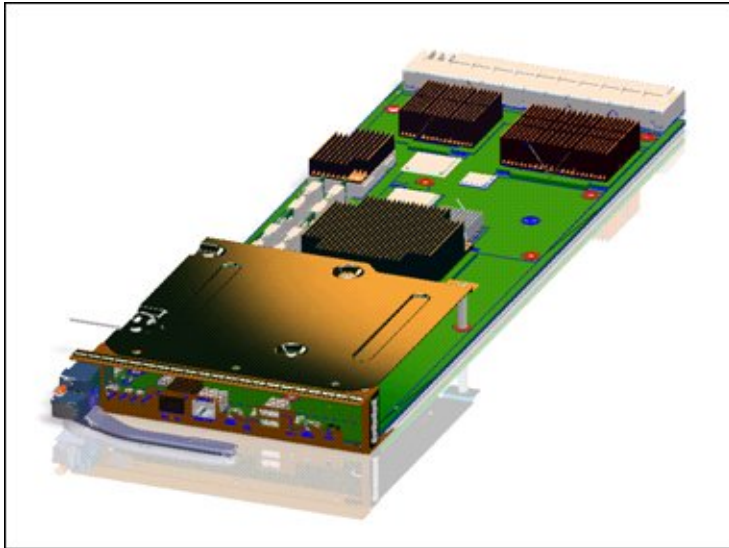


Figure 3. 16-Gbps Cisco MDS 9700 Series Supervisor-1 Module

Cisco MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module

The Cisco MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module (Figure 4) delivers predictable performance, scalability, and innovative features to support private and virtualized data centers. With industry-leading 768 line-rate 32-Gbps Fibre Channel ports per director, the 32-Gbps 48-port Fibre Channel switching module meets the high-performance needs for flash-memory and Non-Volatile Memory Express (NVMe) over Fibre Channel workloads. It offers innovative services including virtual machine awareness, on-board Fibre Channel analytics engine, E-port and F-port diagnostics, integrated VSANs, IVR, and port channels. It delivers full-duplex aggregate performance of 1536 Gbps, making it well suited for high-speed 32-Gbps storage subsystems, 32-Gbps Inter-Switch Links (ISLs), high-performance virtualized servers, and all-flash and NVMe arrays.

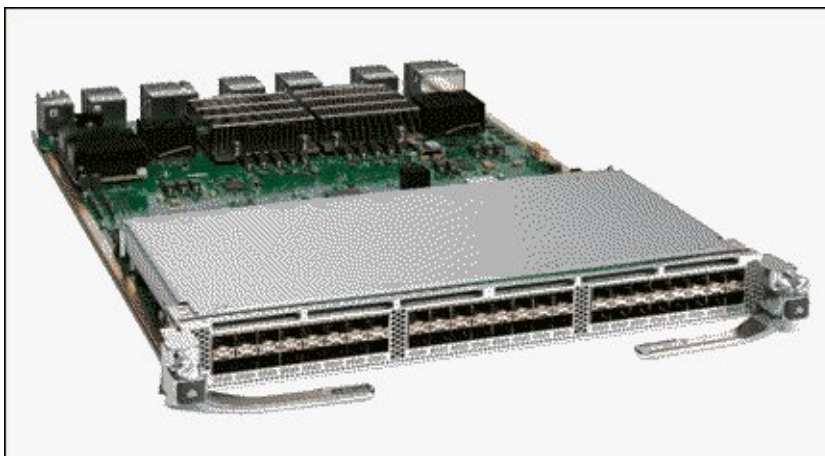


Figure 4. Cisco MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module

The MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module enables administrators to scale and consolidate SAN deployments with fewer hardware components. Your SAN administrators can consolidate workloads from hundreds of high-performance virtual machines and scale them with incremental updates as your SAN grows while protecting your existing investment.

This switching module ships with a built-in analytics engine. The engine can analyze real-time Fibre Channel exchanges and report on various metrics in detail, enabling comprehensive and timely monitoring of any potential performance problems among SAN edge devices. The on-board network processing unit (NPU) in the module allows I/O-level metrics to be computed at every switch. The NPU can monitor all flows on all ports at line rate. The NPU examines every exchange passing through the 32-Gbps application-specific integrated circuit (ASIC) to capture flow metrics such as exchange completion time, maximum number of outstanding exchanges, data access latency, read and write IOPS, throughput, logical unit number (LUN) access pattern (sequential or random), and I/O block sizes.

The switching module is hot swappable and compatible with 4-, 8-, 16-, and 32-Gbps Fibre Channel interfaces. This module also supports hot-swappable Enhanced Small Form-Factor Pluggable (SFP+) transceivers. Individual ports can be configured with Cisco 32-, 16-, and 8-Gbps SFP+ transceivers. Each port supports 500 buffer credits for exceptional extensibility without the need for additional licenses. With the Cisco Enterprise Package license, up to 8191 buffer credits can be allocated to an individual port, enabling full link bandwidth over long distances with no degradation in link utilization.

The 32-Gbps Fibre Channel switching module also provides existing features such as predictable performance, high availability, advanced traffic management capabilities, integrated VSAN and IVR, resilient high-performance ISLs, hardware-assisted slow-drain support, comprehensive security frameworks, fault detection and isolation of errored packets, and sophisticated diagnostics.

Main features

The Cisco MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module offers the following main features:

- **Outstanding SAN performance:** The combination of the 32-Gbps Fibre Channel switching module and Fabric-1 crossbar switching modules enables up to 1.5 terabits per second (Tbps) of Fibre Channel throughput between the modules in each direction for each payload slot in the Cisco MDS 9700 Series Multilayer Directors. The MDS 9700 Series architecture, which is based on central arbitration and a crossbar fabric, provides 32-Gbps line-rate, nonblocking, predictable performance across all traffic conditions for every port in the chassis.
- **High availability:** The MDS 9700 Series directors provide outstanding availability and reliability. They are the industry's first director-class switches considered to support mission-critical workloads because they enable redundancy on all major components, including the fabric card. They also provide grid redundancy on the power supply and 1+1 redundant supervisors. Users can add a fabric card to enable N+1 fabric redundancy at 16-Gbps Fibre Channel speeds. The suggested number of modules per chassis is 6 if there are 32-Gbps line linecards with 32-Gbps transceivers. If you do not want to upgrade, or you want to partially upgrade, review Table 1.

Table 1. Number of Fabric Modules needed according to ports running at 32 Gbps performance in a 48-port 32-Gbps linecard

# of ports	Running at (Performance)	# of fabric modules needed	Restrictions
24	32 Gbps	3	Other 24 ports shut down
32	32 Gbps	4	Other 16 ports shut down
40	32 Gbps	5	Other 8 ports shut down
48	32 Gbps	6	No restrictions

- **Industry-leading scalability:** The MDS 9700 Series directors combine industry-leading scalability with performance to meet the needs of even the largest data center storage environments. The Cisco MDS 9718 Multilayer Director supports up to 48 Tbps of Fibre Channel system bandwidth and 768 2-, 4-, 8-, 16-, and 32-Gbps full line-rate autosensing Fibre Channel ports in a single chassis. The Cisco

MDS 9710 Multilayer Director supports up to 24 Tbps of Fibre Channel system bandwidth and up to 384 2-, 4-, 8-, 16-, and 32-Gbps full line-rate autosensing Fibre Channel ports in a single chassis. The smaller Cisco MDS 9706 Multilayer Director supports up to 12 Tbps of Fibre Channel system bandwidth and 192 2-, 4-, 8-, 16-, and 32-Gbps full line-rate autosensing Fibre Channel ports in a single chassis. The MDS 9700 Series directors can support both the Cisco MDS 9700 48-Port 16-Gbps Fibre Channel Switching Module and the Cisco MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module in the same chassis, providing compatibility with the customer's existing system.

- **Intelligent network services** : VSAN technology, ACLs for hardware-based intelligent frame processing, and fabricwide QoS enable migration from SAN islands to enterprise wide storage networks.
- **Fibre Channel Redirect (FC-Redirect)**: FC-Redirect infrastructure provides the capability to redirect a flow to a specific service engine in the fabric to provide intelligent services such as Cisco Data Mobility Manager and Cisco MDS 9000 I/O Accelerator.
- **Integrated hardware-based VSANs and IVR**: VSANs are integrated into port-level hardware so that any port in a system or fabric can be assigned to any VSAN. The IVR provides line-rate routing between any ports in a system or fabric without the need for external routing appliances.
- **Intelligent storage services** : The MDS 9700 Series directors support intelligent service capabilities on other Cisco MDS 9000 Family switches to provide services such as acceleration of storage applications for data replication and backup.
- **Smart Zoning**: When the Smart Zoning feature is enabled, MDS 9700 Series fabrics provision the hardware ACL entries, specified by the zone set, more efficiently. This feature helps prevent superfluous entries that might allow servers (initiators) to talk to other servers or allow storage devices (targets) to talk to other storage devices. This feature makes feasible larger zones with multiple initiators and multiple targets without excessive consumption of hardware resources. Smart Zones can correspond to applications, application clusters, hypervisor clusters, and other data center entities, saving the time that administrators previously spent creating many small zones and enabling automation of zoning tasks.
- **Virtual machine transparency** : The MDS 9700 Series provides deterministic hardware performance and a comprehensive feature set that allows virtual machines to have the same SAN attributes as a physical server. On a per-virtual machine basis, Cisco NX-OS Software offers VSANs, QoS policies, access control, performance monitoring, and data protection to promote the scalability and mobility of virtual machines. Cisco Prime™ Data Center Network Manager (DCNM) enables rapid troubleshooting in mission-critical virtualized environments by providing end-to-end visibility from the virtual machine to storage with resource allocation, performance measurements, and predictions available on a per-virtual machine basis.
- **Comprehensive security** : The MDS 9700 Series devices supports services including VSANs, hardware-enforced zoning, ACLs, per-VSAN role-based access control (RBAC), and Cisco TrustSec Fibre Channel link encryption. The comprehensive security framework consists of RADIUS and TACACS+, FC-SP, SFTP, SSH Protocol, and SNMPv3. The Cisco TrustSec Fibre Channel link encryption delivers transparent, hardware-based 32-Gbps line-rate AES 128-bit encryption of Fibre Channel data on 32-Gbps Fibre Channel switching modules.
- **Resilient high-performance ISLs**: The MDS 9700 Series 32-Gbps Fibre Channel switching modules support high-performance ISLs consisting of 32-Gbps secure Fibre Channel. Fibre Channel switching modules also support port-channel technology for additional scalability and resilience. Administrators can group up to 16 links spanning any port on any module in a chassis into a logical link. Administrators can also allocate up to 8191 buffer-to-buffer credits to a single Fibre Channel port, providing industry-leading extension of storage networks to up to 4000 kilometers at 4 Gbps, 2000 kilometers at 8 Gbps, 1000 kilometers at 16 Gbps, and 500 kilometers at 32 Gbps, while maintaining full link utilization. The MDS 9700 Series switch architecture helps ensure that frames are never reordered within a switch, leading to optimal application performance because end devices never have to use resources to reorder the frames.

- **Sophisticated diagnostics:** The MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module provides intelligent diagnostics, protocol decoding, E-port diagnostics, and network analysis tools along with an integrated Cisco Call Home capability for greater reliability, faster problem resolution, and reduced service costs.
- **Compatibility:** The MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module can co-exist with previous-generation supported modules on the MDS 9700 Series director.
- **Investment protection:** The MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module can easily be inserted into existing MDS 9700 Series directors without any impact on operations. Existing 16-Gbps customers can transparently move to 32-Gbps speeds without the need for a major equipment upgrade. Cisco continues its tradition of providing multiple generations of speeds (16Gbps FC, 32Gbps FC, 10GbE FCoE, and 40GbE) on the same chassis, providing customers with exceptional investment protection for their existing systems.

Main benefits

The Cisco MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module offers the following benefits:

- **Lower TCO with SAN consolidation:** With the exponential growth of data in today's business environment, organizations need to deploy large-scale SANs in the most efficient and cost-effective ways. To meet scalability requirements while managing TCO, the MDS 9700 Series directors offer the following features:
 - Industry-leading port density of line-rate 32-Gbps Fibre Channel ports per chassis
 - 1.5-Tbps Fibre Channel performance per slot
 - Up to 48-Tbps front-panel Fibre Channel line-rate nonblocking system-level switching
 - Exceptional capabilities with intelligent fabric services
 - VSANs for consolidating individual physical SAN islands while maintaining logical boundaries
 - IVR for sharing resources across VSANs
 - Built-in network processing unit for inline analytics

These features enable the consolidation of an organization's data assets into fewer, larger, and more manageable SANs, thus reducing the hardware footprint and associated capital and operating expenses:

- **Enterprise-class availability:** The MDS 9700 Series was specifically designed from the beginning for high-availability and mission-critical environments. Beyond meeting the basic requirements of nondisruptive software upgrades and redundancy of all critical hardware components, the MDS 9700 Series software architecture offers outstanding greater than five-nines availability.
- **Virtual machine-aware SAN deployment:** The growing adoption of server virtualization in data centers increases the number of hosts attached to the SAN, places higher workloads on the SAN, and requires more storage, thereby increasing the need for SAN services. The Cisco VMpath technology, part of Cisco DCNM, provides end-to-end visibility from the virtual machines to the storage devices. Resource allocation, performance measurements, and predictions are available on a per-virtual machine basis to enable rapid troubleshooting in mission-critical virtualized environments.
- **Advanced traffic management:** The following advanced traffic management capabilities, integrated into every MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module, simplify deployment and optimization of large-scale fabrics:
 - The virtual output queue (VOQ) helps ensure line-rate performance on each port, independent of traffic pattern, by eliminating head-of-line blocking.
 - Up to 8191 buffer-to-buffer credits can be assigned to any individual port for optimal bandwidth utilization across distances.

- o Port channels allow up to 16 physical ISLs to be aggregated into a single logical bundle, providing optimized bandwidth utilization across all links. The bundle can be a mix of any port from any module in the chassis. This approach helps ensure that the bundle can remain active even if a module fails.
- o Fabric Shortest Path First (FSPF)-based multipathing provides the intelligence to load-balance across up to 16 equal-cost paths and dynamically reroute traffic if a switch fails.
- o QoS helps manage bandwidth and control latency to prioritize critical traffic and is available on every port.
- o The lossless network-wide in-order delivery guarantee helps ensure that frames are never reordered within a switch. This guarantee extends across the entire multiswitch fabric, assuming that the fabric is stable and no topology changes are made.
- o Advanced diagnostics and troubleshooting tools: The MDS 9700 Series integrates proactive diagnostics, tools to verify connectivity and route latency and to capture and analyze traffic, thereby simplifying the management of large-scale storage networks. The POST and online diagnostics provide proactive health monitoring. Starting with Cisco MDS 9000 NX-OS Software Release 6.2, the powerful Cisco Generic Online Diagnostics (GOLD) framework replaces the Cisco Online Health Management System (OHMS) diagnostic framework on the new MDS 9700 Series Multilayer Director chassis. GOLD is a suite of diagnostic facilities that verify whether the hardware and internal data paths are operating as designed. Boot-time diagnostics, continuous monitoring, standby fabric loopback tests, and on-demand and scheduled tests are part of the GOLD feature set. This industry-leading diagnostics subsystem enables rapid fault isolation and continuous system monitoring, which are critical features in today's continuously operating environments.
- o Integrated hardware functions support diagnostic capabilities such as Fibre Channel traceroute to identify the exact path and timing of flows, and Cisco SPAN and Remote SPAN (RSPAN) to intelligently capture network traffic. The captured Fibre Channel traffic can be analyzed with the embedded Cisco Fabric Analyzer. Comprehensive port-based and flow-based statistics enable sophisticated performance analysis and SLA accounting.
- o Comprehensive solution for robust security: Addressing the need for stringent security in storage networks, the MDS 9700 Series 32-Gbps Fibre Channel line card offers an extensive security framework to protect the highly sensitive data crossing today's enterprise networks. The MDS 9700 Series employs intelligent packet inspection at the port level, including the application of ACLs for hardware enforcement of zones, VSANs, and advanced port security features. VSANs are used to achieve greater security and stability by providing complete isolation of devices that are connected to the same physical SAN. IVR enables controlled sharing of resources between VSANs.
- o In addition, FC-SP1 provides switch-to-switch and host-to-switch DH CHAP authentication supporting RADIUS or TACACS+ to help ensure that only authorized devices access protected storage networks. Cisco TrustSec1 Fibre Channel link encryption, available on the MDS 9700 Series 32-Gbps modules, allows you to transparently encrypt ISLs at up to line-rate speeds, providing an additional layer of protection for traffic within and between data centers. The MDS 9700 Series supports a fabric binding feature that helps ensure that ISLs are enabled only between specified switches in the fabric binding configuration.
- o Integrated mainframe support: The MDS 9700 Series is mainframe ready, with full support for FICON for IBM z Systems and Linux environments. The MDS 9700 Series supports transport of the FICON protocol in both cascaded and noncascaded fabrics. It also supports a mix of FICON and open-systems Fibre Channel Protocol (FCP) traffic on the same switch.

The MDS 9700 Series 48-port 16-Gbps Fibre Channel Switching Module

The Cisco MDS 48-port 16-Gbps Fibre Channel Switching Module delivers a full-duplex aggregate performance of 768 Gbps, which makes this module suitable for the attachment of high-performance 16 Gbps storage subsystems, 16 Gbps ISLs, and high-performance and virtualized servers.

Figure 5 shows the Cisco MDS 9700 Series 48-port 16-Gbps Fibre Channel Switching Module.

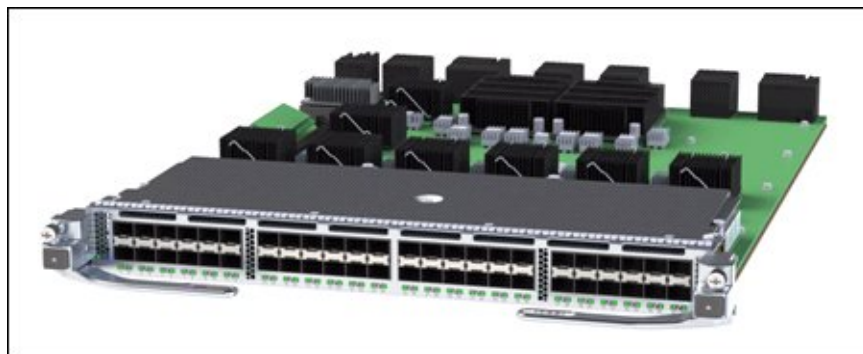


Figure 5. Cisco MDS 9700 Series 48-Port 16-Gbps Fibre Channel Switching Module

The MDS 9700 Series 16-Gbps Fibre Channel Switching Module also provides Cisco VMpath technology to monitor, manage, and control SAN resource allocation and performance on a per-virtual machine basis and map out paths all the way from the server to storage, which enables tracking mission-critical workloads end-to-end.

The MDS 9700 Series Fibre Channel Switching Module is hot-swappable, compatible with 2/4/8/16 Gbps and 10 Gbps interfaces, and supports hot-swappable Enhanced Small Form-Factor Pluggable (SFP+) transceivers. Individual ports can be configured with Cisco 16, 8, or 10 Gbps shortwave or longwave SFP+ transceivers. Each port supports 500 buffer credits for exceptional extensibility without requiring more licensing. With the Cisco Enterprise Package, up to 4095 buffer credits can be allocated to an individual port, which enables full link bandwidth over long distances with no degradation in link usage.

The Cisco MDS 48-port 10 Gbps and 24-port 40 Gbps FCoE switching modules

The MDS 48-port 10 Gbps and the 24-port 40 Gbps FCoE switching modules for the Cisco MDS 9700 Multilayer Directors combine Fibre Channel and FCoE into a single platform, which enables flexible and agile SAN designs, investment protection, reduced costs, and streamlined data-center management and operations. The 48-port 10-Gbps FCoE Switching Module provides the scalability of 384 10 Gbps full line-rate autosensing ports in a single chassis. The 24-port 40 Gbps FCoE Switching Module provides up to 192 40-Gbps full line-rate autosensing ports in a single chassis.

Figure 6 shows the Cisco MDS 9700 Series 10-Gbps FCoE Switching Module.

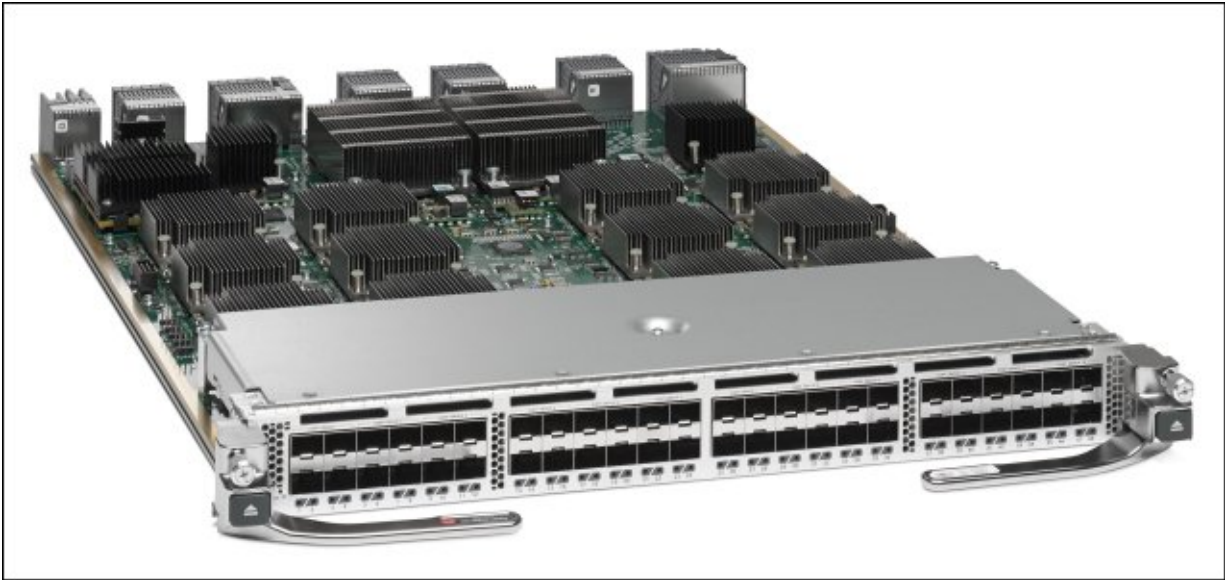


Figure 6. Cisco MDS 9700 Series 48-Port 10-Gbps FCoE Switching Module

Figure 7 shows the MDS 9700 24-port 40-Gbps FCoE Switching Module.

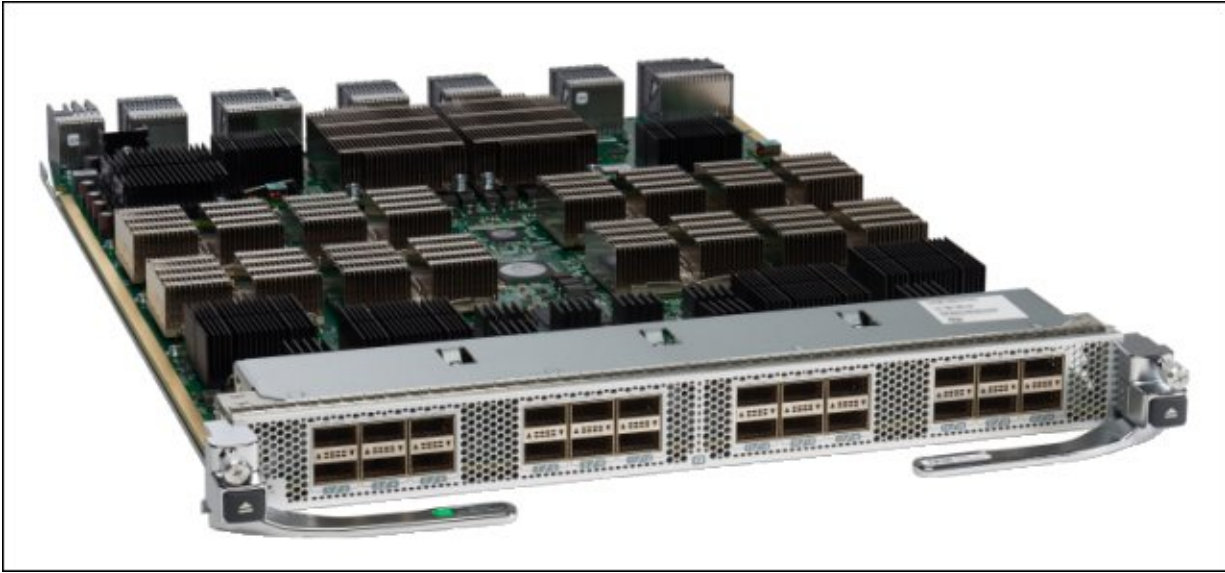


Figure 7. MDS 9700 24-port 40-Gbps FCoE Switching Module

Enterprises can save money, simplify management, reduce power and cooling requirements, and improve flexibility by deploying FCoE, while using the MDS 9700 10-Gbps 48-Port FCoE Module to protect their investment in Fibre Channel SANs. FCoE allows an evolutionary approach to I/O consolidation by preserving all Fibre Channel constructs. It maintains the latency, security, and traffic management attributes of Fibre Channel while preserving investments in Fibre Channel tools, training, and SANs. In addition, FCoE extends Fibre Channel SAN connectivity. Now 100% of the servers that are connected to the network can also be attached to the SAN.

The next-generation Cisco MDS 9700 40-Gbps 24-Port FCoE Module (see Figure 6 on page 13) provides Cisco Unified Fabric connectivity to the SAN core. It empowers midsize and large enterprises that are rapidly deploying cloud-scale applications with ISL consolidation by four to one over traditional 10 Gbps FCoE, and three to one over 16 Gbps FC, and exceptional investment protection for their SANs.

With the 10-Gbps 48-Port FCoE Module and the 40-Gbps 24-port FCoE Module, the Cisco MDS 9700 Multilayer Director family now offers 16-Gbps Fibre Channel, 10-Gbps FCoE and 40-Gbps FCoE capabilities, which provide multiprotocol flexibility for SANs. Now you can extend the benefits of FCoE beyond the access layer to the data center core with full line rate FCoE modules for the Cisco MDS 9700 Series.

Product highlights

The Cisco MDS 9710 for IBM System Networking and its components offer the following main features:

- **Outstanding SAN performance:** The combination of the 16 Gbps Fibre Channel switching modules and Fabric-1 Crossbar switching modules enables up to 1.5 Tbps of front-panel FC throughput between modules in each direction for each of the eight MDS 9710 payload slots. This per-slot bandwidth is double the bandwidth that is needed to support a 48-port 16 Gbps FC module at full line rate. Based on central arbitration and a crossbar fabric, the MDS 9710 architecture provides 16 Gbps line-rate, nonblocking, predictable performance across all traffic conditions for every chassis port.
- **High availability:** The MDS 9710 director class switch enables redundancy on all major components, including the fabric card. It provides Grid Redundancy on Power Supply and 1+1 redundant Supervisors. Users can include a fourth fabric card to enable N+1 Fabric Redundancy at 768 Gbps slot bandwidth. The MDS 9710 combines nondisruptive software upgrades, stateful process restart and failover, and full redundancy of major components for higher availability.
- **Business continuity:** The MDS 9710 director enables large and scalable deployment of SAN extension solutions through the SAN Extension module.
- **Outstanding scalability:** The MDS 9710 director provides up to 24 Tbps of FC backplane bandwidth. A single chassis delivers 384 4/8 Gbps, 2/4/8 Gbps, 4/8/16 Gbps, 8/16/32 Gbps, or 10 Gbps full line-rate autosensing Fibre Channel ports. The 48-port 10-Gbps FCoE Switching Module delivers up to 384 10 Gbps FCoE full line-rate ports, and the 24-port 40-Gbps FCoE Switching Module up to 192 40 Gbps FCoE full line-rate ports, in a single chassis. A single rack supports up to 1152 Fibre Channel ports. The MDS 9700 directors are designed to meet the requirements of even the largest data center storage environments.
- **Deployment of SAN extension solutions:** Enable large and scalable with the MDS 9000 24/10-port SAN Extension Module.
- **Intelligent network services:** VSAN technology, ACLs for hardware-based intelligent frame processing, and fabric-wide QoS enable migration from SAN islands to enterprise-wide storage networks and include the following features:
 - Integrated hardware-based VSANs and IVR: Integration of VSANs into port-level hardware allows any port in a system or fabric to be partitioned to any VSAN. Integrated hardware-based IVR provides line-rate routing between any ports in a system or fabric without the need for external routing appliances.

- o Intelligent storage services: MDS 9710 operates with intelligent service capabilities on other MDS 9000 Family platforms to provide services, such as acceleration of storage applications for data replication and backup, and data migration to hosts and targets that are attached to MDS 9710.
- o SmartZoning: When the SmartZoning feature is enabled, Cisco MDS 9700 Series fabrics provision the hardware access control entries that are specified by the zone set more efficiently, which avoids the superfluous entries that allow servers (initiators) to talk to other servers, or allow storage devices (targets) to talk to other storage devices. This feature makes larger zones with multiple initiators and multiple targets feasible without excessive consumption of hardware resources.

Thus, smart zones can correspond to applications, application clusters, hypervisor clusters, or other data center entities, which saves the time that administrators previously spent creating many small zones, and enables the automation of zoning tasks.

- **Virtual machine transparency:** The Cisco MDS 9700 Series provides deterministic hardware performance and a comprehensive feature set that allows virtual machines to have the same SAN attributes as a physical server. On a per-virtual machine basis, the Cisco NX-OS Software offers VSANs, QoS policies, access control, performance monitoring, and data protection to promote the scalability and mobility of virtual machines.

Cisco Data Center Network Manager for SAN (DCNM-SAN) provides end-to-end visibility all the way from the virtual machine down to storage, with resource allocation, performance measurements, and predictions that are available on a per-virtual machine basis to enable rapid troubleshooting in mission-critical, virtualized environments.

- **Comprehensive security:** The Cisco MDS 9700 Series Family supports a comprehensive security framework. It consists of RADIUS and TACACS+, FC-SP, SFTP, SSH Protocol, and SNMPv3 implementing VSANs, hardware-enforced zoning, ACLs, and per-VSAN role-based access control.
- **Unified SAN management:** The Cisco MDS 9700 Series includes built-in storage network management with all features available through a command-line interface (CLI) or Cisco DCNM, a centralized management tool that simplifies managing unified fabrics. DCNM supports the federation of up to 10 Cisco DCNM servers to manage up to 150,000 devices by using a single management pane.
- **Sophisticated diagnostic tests:** The MDS 9710 provides intelligent diagnostic tests, protocol decoding, network analysis tools, and integrated Call Home capability for greater reliability, faster problem resolution, and reduced service costs.
- **Multiprotocol intelligence:** The multilayer architecture of the MDS 9710 enables the following consistent feature set over a protocol-independent switch fabric. The MDS 9706 transparently integrates Fibre Channel, FCoE, and FICON. Consider the following points:
 - o The MDS 9710 supports 2/4/8/16 Gbps and 10 Gbps ports on the 48-port 16 Gbps Fibre Channel switching module for deployment in open systems and FICON environments.
 - o The MDS 9710 supports 2/4/8/16/32 Gbps ports on the Cisco MDS 9700 48-Port 32 Gbps Fibre Channel Switching Module for deployment in open systems.
 - o The MDS 9710 is mainframe-ready, with full support for IBM z Systems FICON and Linux environments.
 - o The MDS 9706 supports 10 Gbps FCoE with the 48-port 10 Gbps FCoE switching module and 40 Gbps FCoE with the 24-port 40 Gbps FCoE switching module.
 - o Extends connectivity from FCoE and Fibre Channel fabrics to FCoE and Fibre Channel storage devices.

Main benefits

The MDS 9710 features the benefits that are described in this section.

Reduce TCO with SAN Consolidation

With data growing exponentially, organizations need efficient, cost-effective, large-scale SANs. You can scale while managing TCO with industry-leading port densities of up to 384 32 Gbps Fibre Channel ports or 16 Gbps Fibre Channel ports per chassis. You can deploy 1.5-Tbps front-panel Fibre Channel performance per slot and up to 24-Tbps front-panel Fibre Channel line-rate nonblocking system-level switching.

Intelligent fabric services, VSANs for consolidating physical SAN islands while maintaining logical boundaries, and IVR for sharing resources across VSANs can be deployed. You can consolidate your data into fewer, larger, and more manageable SANs, which reduces the hardware footprint and associated capital and operating expenses. Multihop FCoE protects investments in storage infrastructure with any-to-any connectivity across multiple protocols.

Enterprise-class availability

The MDS 9710 is designed from the beginning for high availability. In addition to meeting the basic requirements of nondisruptive software upgrades and redundancy of all critical hardware components, the MDS 9710 software architecture offers outstanding availability. The MDS 9700 Series Supervisor Modules automatically restart failed processes, which makes the MDS 9710 exceptionally robust. In the rare event that a supervisor module is reset, complete synchronization between the active and standby supervisor modules helps ensure stateful failover with no disruption of traffic.

The MDS 9710 director provides redundancy on all major active hardware components. Table 2 lists the redundancy that is available across all components.

Table 2. Redundancy details for the MDS 9710

Item	Redundancy
Supervisors	1+1
Power supplies	Grid redundancy
Fabrics	N+1 redundancy

High availability is implemented at the fabric level by using robust and high-performance ISLs. PortChannel allows users to aggregate up to 16 physical links into one logical bundle. The bundle can consist of any speed-matched ports in the chassis, which helps ensure that the bundle can remain active if a port, ASIC, or module fails. ISLs in a PortChannel can have significantly different lengths.

This capability is valuable in campus and metropolitan area network (MAN) environments because logical links can now be spread over multiple physical paths, which helps ensure uninterrupted connectivity even if one of the physical paths is disrupted. The MDS 9710 provides outstanding high availability, which helps ensure that solutions exceed the 99.999% uptime requirements of today's most demanding environments.

Business Transformation with Enterprise Cloud Deployment

With industry-leading scalability and pay-as-you-grow flexibility, the MDS 9710 enables you to quickly scale enterprise clouds up or down as needed. You also receive the following benefits:

- Multihop FCoE provisions storage in a multiprotocol unified fabric
- Robust security protects multitenancy cloud applications

- Predictable high performance meets stringent SLAs
- Resilient connectivity helps ensure always-on cloud infrastructure
- Advanced traffic management capabilities (such as QoS) quickly and cost-efficiently allocate elastic network capabilities to cloud applications

Cisco DCNM also provides resource monitoring and capacity planning on a per-virtual machine basis. You can efficiently complete the following tasks:

- Consolidate enterprise cloud deployments
- Federate up to 10 Cisco DCNM servers to easily manage large-scale clouds
- Use information through Storage Management Initiative Specification (SMI-S)-based developer APIs to deliver IT as a service

Advanced traffic management

Deploy and optimize large-scale fabrics more easily by using the following features:

- **Virtual Output Queuing:** Helps ensure line-rate performance on each port (independent of traffic patterns) by eliminating head-of-line blocking.
- **Up to 4095 Buffer-to-Buffer Credits:** By using extended credits, allows up to 4095 buffer credits from a pool of more than 6000 buffer credits for a module to be allocated to ports as needed to greatly extend the distance for Fibre Channel SANs. Alternatively, 4095 buffer credits can be assigned to an individual port for optimal bandwidth utilization across distance.
- **PortChannels:** Allows users to aggregate up to 16 physical ISLs into a single logical bundle, which provides optimized bandwidth usage across all links. The bundle can consist of any speed-matched ports from any module in the chassis, which helps ensure that the bundle can remain active even if there is a module failure.
- **FSPF-Based Multipathing:** Provides the intelligence to load balance across up to 16 equal cost paths and dynamically reroute traffic if there is a switch failure.
- **QoS:** Helps manage bandwidth and control latency to prioritize critical traffic.

Ease of management

The MDS 9710 presents the user with a consistent and logical CLI. By using the CLI, customers can enable debugging modes for each switch feature and view a real-time updated activity log of control protocol exchanges. Each log entry is timestamped and listed in chronological order.

Cisco DCNM (formerly Cisco Fabric Manager) is an easy-to-use application that simplifies management across multiple switches and converged fabrics. Its intuitive GUI simplifies day-to-day operations of Cisco unified fabrics in virtualized data center environments.

The Cisco DCNM offers the following functionality:

- Monitoring of events and performance historically and at scale
- Wizard- and template-based provisioning of Cisco NX-OS technologies and services
- Cisco VMpath analytics, with dynamic topology views for extended visibility into virtual infrastructure
- Resource management through trend analysis of inventory and performance
- Rule-based event notification and filtering
- Role-based access control to provide separation between network and storage teams

You can scale to large deployments through scale-out server architecture with automated failover capability. DCNM provides a resilient management system that centralizes infrastructure and path monitoring across geographically dispersed data centers. The Cisco DCNM base management function is available at no charge, and advanced features are unlocked with a license.

Comprehensive solution for robust security

The extensive security framework of the MDS 9710 protects sensitive data that is crossing enterprise networks. It features intelligent, port-level packet inspection, including the use of ACLs for hardware enforcement of zones, VSANs, and advanced port security features. VSANs are used to achieve greater security and stability by providing complete isolation of devices that are connected to the same physical SAN. IVR enables controlled sharing of resources between VSANs.

In addition, FC-SP provides switch-to-switch and host-to-switch DH-CHAP that supports RADIUS or TACACS+. This feature ensures that only authorized devices access protected storage networks.

Advanced diagnostic and troubleshooting tools

Managing large-scale storage networks requires proactive diagnostics, tools to verify connectivity and route latency, and traffic analysis. A comprehensive tool set is delivered for analyzing, troubleshooting, and debugging storage networks. POST and online diagnostics proactively monitor system health. The exact path and timing of flows can be identified with capabilities, such as Fibre Channel traceroute. Network traffic can be captured by using Cisco SPAN and RSPAN. Then, traffic can be analyzed by using the Cisco Fabric Analyzer, which is an embedded Fibre Channel analyzer. You gain sophisticated performance analysis and SLA accounting by collecting port-based and flow-based statistics.

Consolidation, reduced complexity, and lower power consumption

With the ongoing increase in server workloads, converged networks reduce complexity and provide lower overall data center power consumption, which extends the lifecycle of assets. Moreover, a converged network improves SAN attachment rates, which simplifies virtual machine mobility.

The benefits that I/O consolidation brings to the access layer can now be achieved in the core of the data center as well with the capability to consolidate the network in the core, the MDS 9700 10 Gbps and 40 Gbps FCoE Modules bring an immediate benefit by reducing data center complexity. This type of approach brings the following important benefits to the data center:

- Investment protection: FCoE is an evolutionary technology with the same management model as Fibre Channel and with the roadmap of Ethernet, which is rapidly shifting from 10 to 40 Gbps. With FCoE, you can preserve your investments in Fibre Channel tools, training, and SANs. The MDS 9700 FCoE modules provide investment protection for Fibre Channel storage by transparently bridging the gap between FCoE SANs (traffic that originates from server-side networks) and Fibre Channel SANs (traffic that is heading toward storage arrays), as shown in Figure 8.

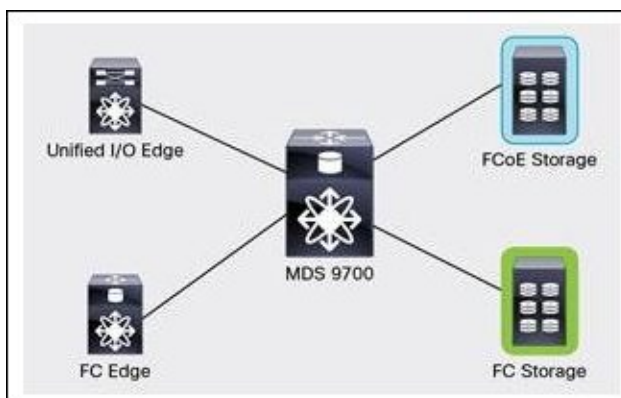


Figure 8. MDS 9700 Interconnects FCoE and FC SANs

- **Agility:** Over time, a converged network provides a more efficient usage of network capacity for LAN and SAN deployments. Moreover, increased bandwidth capacity over time results in improved responsiveness for all traffic types. The end-to-end benefits of FCoE include the capability to set up, move, and change physical and virtual assets with greater speed and with fewer points of failure.
- **Simplification:** Through consolidation, a converged network can reduce complexity and provide a greater return on investment (ROI).
- **Better convergence:** The 40 Gbps links benefit from lower latency than lower-bandwidth links, which brings better-performing converged storage workloads to your storage array. Higher bandwidth also helps ensure less ISL congestion for newer converged storage workloads that are moving to the storage arrays, for example, SCSI over IP (iSCSI) and FCoE workloads with a combination of Nexus series switches.
- **End to End FCoE:** The 40 Gbps FCoE module can also support connectivity to FCoE initiators and targets that send only FCoE traffic, which provides a way to deploy a dedicated FCoE SAN without requiring any convergence at 40 Gbps.

Integrated mainframe support

The MDS 9710 is mainframe-ready, with full support for IBM z Systems FICON and Linux environments. The MDS 9710 supports transporting the FICON protocol in cascaded and non-cascaded fabrics, and an intermix of FICON and open systems Fibre Channel Protocol traffic on the same switch.

Cisco MDS 9710 Multilayer Director for IBM System Networking product specifications

The product specifications for the Cisco MDS 9710 Multilayer Director for IBM System Networking are described in this section. The MDS 9710 Multilayer Director supports FC connectivity for servers and storage. The 9710-E08 model supports all the FICON features and functions that are listed in this section, and requires Cisco MDS NX-OS 6.2.5a or later.

For more information about the Cisco MDS 9710 Multilayer Director for IBM System Networking, see this website:

<http://www.cisco.com/c/en/us/products/collateral/storage-networking/mds-9700-series-multilayer-directors/index.html>

All of the features that are shown in this view are included in the IBM offering.

Table 3 lists the product specifications for the Cisco MDS 9710 Multilayer Director for IBM System Networking.

Table 3. Product specifications for the Cisco MDS 9710 Multilayer Director for IBM System Networking (part 1 of 3)

Feature	Description
Product compatibility	Cisco MDS 9000 Family
Operating systems	For the most current and complete information, see the IBM System Storage Interoperation Center (SSIC): http://ibm.co/1Pmc6de
Optional features	<ul style="list-style-type: none"> ● MDS 9000 24/10-port SAN Extension Module (3650) ● MDS 9700 24-port 40-Gbps FCoE Switching Module (3640) ● MDS 9700 48-Port 10-Gbps FCoE Switching Module (3620) ● MDS 9700 Series 48-port 16-Gbps Fibre Channel Switching Module (3648) ● MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module (3649) ● MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module Bundle (3645) ● MDS 9700 Series Supervisor-1 Module (3601) ● MDS 9700 Series Enterprise Package (7610) ● MDS 9700 Series DCNM for SAN Advanced Edition (7611) ● MDS 9700 Mainframe Package (7612) ● MDS 9700 Series 3000 W AC power supply (5960) ● Small form-factor pluggables (SFPs) ● Fans
Software compatibility	Cisco MDS NX-OS Software Release 6.2.3 or later. NX-OS 6.2.5 is recommended. NX-OS 6.2.5a is required for FICON support. The FCoE switching module requires Cisco MDS NX-OS Release 6.2.7 or later. The 48-port 32 Gbps Fibre Channel switching module requires Cisco MDS NX-OS Release 8.1(1) or later.
Chassis slot configuration	<ul style="list-style-type: none"> ● Line-card slots: 8 ● Supervisor slots: 2 ● Crossbar switching fabric slots: 6* ● Fan trays: Three fan trays at the back of the chassis ● Power supply bays: 8
Performance/Scalability	<ul style="list-style-type: none"> ● Up to 24-Tbps front-panel Fibre Channel switching bandwidth and 10.5 Tbps of FCoE bandwidth ● Supported Fibre Channel port speeds: <ul style="list-style-type: none"> ○ 4/8-Gbps autosensing, optionally configurable ○ 4/8/16 Gbps autosensing, optionally configurable ○ 8/16/32-Gbps autosensing, optionally configurable ○ 10-Gbps Fibre Channel ● Supported FCoE port speeds: 10 Gbps fixed bandwidth: <ul style="list-style-type: none"> ○ 2/4/8 Gbps autosensing optionally configurable ● Buffer credits: 48-port line-rate 16-Gbps Fibre Channel modules: <ul style="list-style-type: none"> ○ Up to 500 per port (dedicated-mode ports) standard ○ Up to 4095 on an individual port (dedicated-mode ports with optional Cisco MDS 9700 Enterprise Package license activated) ● Buffer credits: 48-port line-rate 32-Gbps Fibre Channel module: <ul style="list-style-type: none"> ○ Default credits per port: 500 ○ With Enterprise license, 8300 shared among a single port group of 16 ports ● Ports per chassis (one of the following): <ul style="list-style-type: none"> ○ Up to 384 2/4/8/10/16/32 Gbps Fibre Channel ports ○ Up to 384 10 Gbps FCoE full line-rate ports ○ Up to 192 40 Gbps FCoE full line rate ports ● PortChannel: Up to 16 ports (the channel can span any speed-matched port on any module in the chassis)

*A minimum of three fabrics are required to support fully populated chassis with 8 x 48 Port 16 Gbps FC cards or 8 X 48 port 10 Gbps FCoE cards. Four fabrics are required to provide N + 1 protection.

Table 3. Product specifications for the Cisco MDS 9710 Multilayer Director for IBM System Networking (part 2 of 3)

Feature	Description
Fabric services	<ul style="list-style-type: none"> ● Name server ● Registered State Change Notification (RSCN) ● Login services ● Fabric Configuration Server (FCS) ● Broadcast ● In-order delivery
Advanced functions	<ul style="list-style-type: none"> ● VSAN ● IVR ● PortChannel with multipath load balancing ● QoS-flow-based, zone-based ● N_Port ID virtualization
Diagnostic tests and troubleshooting tools	<ul style="list-style-type: none"> ● POST diagnostic tests ● Online diagnostic tests ● Internal port loopbacks ● SPAN and RSPAN ● Fibre Channel Traceroute ● Fibre Channel Ping ● Fibre Channel Debug ● Cisco Fabric Analyzer ● Syslog ● Online system health ● Port-level statistics ● Real-Time Protocol Debug
Network security	<ul style="list-style-type: none"> ● VSANs ● ACLs ● Per-VSAN RBAC ● Fibre Channel zoning: <ul style="list-style-type: none"> ○ N_Port WWN ○ N_Port FC-ID ○ Fx_Port WWN ○ Fx_Port WWN and interface index ○ Fx_Port domain ID and interface index ○ Fx_Port domain ID and port number ● FC-SP: <ul style="list-style-type: none"> ○ DH-CHAP switch-switch authentication ○ DH-CHAP host-switch authentication ● Port security and fabric binding ● Management access: <ul style="list-style-type: none"> ○ SSHv2 implementing AES ○ SNMPv3 implementing AES ○ SFTP
FICON	<ul style="list-style-type: none"> ● FC-SB-3 compliant ● Cascaded FICON fabrics ● Intermix of FICON and Fibre Channel FCP traffic ● CUP management interface

Table 3. Product specifications for the Cisco MDS 9710 Multilayer Director for IBM System Networking (part 3 of 3)

Feature	Description
Serviceability	<ul style="list-style-type: none"> ● Configuration file management ● Nondisruptive software upgrades for Fibre Channel interfaces ● Call Home ● Power-management LEDs ● Port beaconing ● System LED ● SNMP traps for alerts ● Network boot
Reliability and availability	<ul style="list-style-type: none"> ● Online, nondisruptive software upgrades ● Stateful nondisruptive supervisor module failover ● Hot-swappable redundant supervisor modules ● Hot-swappable redundant crossbar modules ● Hot-swappable 2N redundant power ● Hot-swappable fan trays with integrated temperature and power management ● Hot swappable Enhanced SFP (SFP+) optics (2/4/8/10/16 Gbps) ● Hot-swappable switching modules ● Stateful process restart ● Any module, any port configuration for PortChannels ● Fabric-based multipathing ● Per-VSAN fabric services ● Online diagnostic tests ● Port tracking ● Virtual Routing Redundancy Protocol (VRRP) for management
Network management	<ul style="list-style-type: none"> ● Access methods through Cisco MDS 9700 Series Supervisor-1 Module: <ul style="list-style-type: none"> ○ Out-of-band 10/100/1000 Ethernet port ○ RS-232 serial console port ○ In-band IP over Fibre Channel ● Access methods through Cisco MDS 9710 Family Fibre Channel switching module: In-band FICON CUP over Fibre Channel ● Access protocols: <ul style="list-style-type: none"> ○ CLI-using console and Ethernet ports ○ SNMPv3-using Ethernet port and in-band IP over Fibre Channel access ○ FICON CUP ● Distributed Device Alias service ● Network security: <ul style="list-style-type: none"> ○ Per-VSAN role-based access control by using RADIUS-based and TACACS+-based authentication, authorization, and accounting (AAA) functions ○ SFTP ○ SSHv2 implementing AES ○ SNMPv3 implementing AES ● Management applications: <ul style="list-style-type: none"> ○ Cisco MDS 9000 Family CLI ○ Cisco Data Center Network Manager
Programming interface	<ul style="list-style-type: none"> ● Scriptable CLI ● Data Center Network Manager web services API ● DCNM GUI
Physical dimensions	<ul style="list-style-type: none"> ● Dimensions (H x W x D): 61.9 x 43.9 x 86.4 cm (24.35 in. x 17.3 in. x 34.0 in.) ● 14 RU
Weight	<ul style="list-style-type: none"> ● Chassis (includes fans): 84.2 kg (185.5 lbs) ● Power supply (3000W AC): 2.7 kg (6 lbs) ● Fabric module: 5.0 kg (11 lbs) ● Cisco MDS 9700 Series Supervisor-1 module: 3.2 kg (7 lbs)

Table 4 lists the switching capabilities per fabric.

Table 4. Switching capabilities per fabric

Switching capability per fabric	Number of fabric cards	Front panel Fibre Channel bandwidth per slot	FCoE bandwidth per slot
	1	256 Gbps	220 Gbps
	2	512 Gbps	440 Gbps
	3	768 Gbps	660 Gbps
	4	1024 Gbps	880 Gbps
	5	1280 Gbps	1100 Gbps
	6	1536 Gbps	1320 Gbps

Table 5 lists the supported protocols for the Cisco MDS 9710 Multilayer Director for IBM System Networking and its components.

Table 5. Supported protocols for the Cisco MDS 9710 Multilayer Director for IBM System Networking (part 1 of 3)

Supported standards	
Fibre Channel and FCoE protocols	<ul style="list-style-type: none"> • Fibre Channel standards (part 1): <ul style="list-style-type: none"> o FC-PH, Revision 4.3 (ANSI INCITS 230-1994) o FC-PH, Amendment 1 (ANSI INCITS 230-1994/AM1-1996) o FC-PH, Amendment 2 (ANSI INCITS 230-1994/AM2-1999) o FC-PH-2, Revision 7.4 (ANSI INCITS 297-1997) o FC-PH-3, Revision 9.4 (ANSI INCITS 303-1998) o FC-PI, Revision 13 (ANSI INCITS 352-2002) o FC-PI-2, Revision 10 (ANSI INCITS 404-2006) o FC-PI-3, Revision 4 (ANSI INCITS 460-2011) o FC-PI-4, Revision 8 (ANSI INCITS 450-2008) o FC-PI-5, Revision 6 (ANSI INCITS 479-2011) o FC-FS, Revision 1.9 (ANSI INCITS 373-2003) o FC-FS-2, Revision 1.01 (ANSI INCITS 424-2007) o FC-FS-2, Amendment 1 (ANSI INCITS 424-2007/AM1-2007) o FC-FS-3, Revision 1.11 (ANSI INCITS 470-2011) o FC-LS, Revision 1.62 (ANSI INCITS 433-2007) o FC-LS-2, Revision 2.21 (ANSI INCITS 477-2011) o FC-SB-4, Revision 3.0 (ANSI INCITS 466-2011) o FC-SB-3, Revision 1.6 (ANSI INCITS 374-2003) o FC-SB-3, Amendment 1 (ANSI INCITS 374-2003/AM1-2007) o FC-SW-2, Revision 5.3 (ANSI INCITS 355-2001) o FC-SW-3, Revision 6.6 (ANSI INCITS 384-2004) o FC-SW-4, Revision 7.5 (ANSI INCITS 418-2006) o FC-SW-5, Revision 8.5 (ANSI INCITS 461-2010) o FC-GS-3, Revision 7.01 (ANSI INCITS 348-2001) o FC-GS-4, Revision 7.91 (ANSI INCITS 387-2004) o FC-GS-5, Revision 8.51 (ANSI INCITS 427-2007) o FC-GS-6, Revision 9.4 (ANSI INCITS 463-2010) o FCP, Revision 12 (ANSI INCITS 269-1996) o FCP-2, Revision 8 (ANSI INCITS 350-2003) o FCP-3, Revision 4 (ANSI INCITS 416-2006) o FCP-4, Revision 2 o FCP-4, Revision 2b (ANSI INCITS 481-2011) o FC-SB-2, Revision 2.1 (ANSI INCITS 349-2001) o FC-SB-3, Revision 1.6 (ANSI INCITS 374-2003)

Table 5. Supported protocols for the Cisco MDS 9710 Multilayer Director for IBM System Networking (part 2 of 3)

Supported standards	
Protocols	<ul style="list-style-type: none"> ● Fibre Channel standards (part 2): <ul style="list-style-type: none"> ○ FC-BB-2, Revision 6.0 (ANSI INCITS 372-2003) ○ FC-BB-3, Revision 6.8 (ANSI INCITS 414-2006) ○ FC-BB-4, Revision 2.7 (ANSI INCITS 419-2008) ○ FC-BB-5, Revision 2.0 (ANSI INCITS 462-2010) ○ FC-VI, Revision 1.84 (ANSI INCITS 357-2002) ○ FC-SP, Revision 1.8 (ANSI INCITS 426-2007) ○ FC-SP-2, Revision 2.71 (ANSI INCITS 496-2012) ○ FAIS, Revision 1.03 (ANSI INCITS 432-2007) ○ FAIS-2, Revision 2.23 (ANSI INCITS 449-2008) ○ FC-IFR, Revision 1.06 (ANSI INCITS 475-2011) ○ FC-FLA, Revision 2.7 (INCITS TR-20-1998) ○ FC-PLDA, Revision 2.1 (INCITS TR-19-1998) ○ FC-Tape, Revision 1.17 (INCITS TR-24-1999) ○ FC-MI, Revision 1.92 (INCITS TR-30-2002) ○ FC-MI-2, Revision 2.6 (INCITS TR-39-2005) ○ FC-MI-3, Revision 1.03 (INCITS TR-48-2012) ○ FC-DA, Revision 3.1 (INCITS TR-36-2004) ○ FC-DA-2, Revision 1.06 (INCITS TR-49-2012) ○ FC-MSQS, Revision 3.2 (INCITS TR-46-2011) ● FC-Tape, Revision 1.17 (INCITS TR-24-1999) ● FC-MI, Revision 1.92 (INCITS TR-30-2002) ● FC-MI-2, Revision 2.6 (INCITS TR-39-2005) ● FC-DA, Revision 3.1 (INCITS TR-36-2004) ● Class of service: Class 2, Class 3, and Class F ● Fibre Channel features: <ul style="list-style-type: none"> ○ Fibre Channel standard port types: E, F, FL, and B ○ Fibre Channel enhanced port types: SD, ST, and TE ○ T11 standards-compliant FC-BB-5 Revision 2.0 ○ T11 standards-compliant FCoE ○ T11 FCoE Initialization Protocol (FIP) (FC-BB-5) ○ Fibre Channel forwarding (FCF) ○ FCoE Forwarder (FCF) ○ Multihop FCoE with virtual E (VE) port support ○ Converged Enhanced Ethernet (CEE) interoperability ○ Direct attachment of FCoE targets ○ Fibre Channel enhanced port types: VE, TE, and VF ○ F-port trunking ○ F-port channeling ○ VSANs ○ Fibre Channel PortChannel ○ VSAN trunking ○ Fabric Device Management Interface (FDMI) ○ Fibre Channel ID (FCID) persistence ○ Distributed device alias services ○ In-order delivery

Table 5. Supported protocols for the Cisco MDS 9710 Multilayer Director for IBM System Networking (part 3 of 3)

Supported standards	
Protocols (continued)	<ul style="list-style-type: none"> ● Fibre Channel features (continued): <ul style="list-style-type: none"> ○ Port tracking ○ IPv6, IPv4, and ARP over Fibre Channel (RFC 4338) ○ Extensive IETF-standards-based TCP/IP, SNMPv3, and remote monitoring (RMON) MIBs ○ CEE DCB: <ul style="list-style-type: none"> ● Priority flow control (PFC) ● Data Center Bridging Exchange (DCBX) ○ Enhanced transmission selection (ETS) ○ N-port virtualization (NPV) ○ N-port ID virtualization (NPIV) ○ Fabric services: Name server, registered state change notification (RSCN), login services, and name server zoning ○ Per-VSAN fabric services ○ Cisco Fabric Services ○ Fabric Shortest Path First (FSPF) ○ Diffie-Hellman Challenge Handshake Authentication Protocol (DH-CHAP) and Fibre Channel Security Protocol (FC-SP) ○ Host-to-switch and switch-to-switch FC-SP authentication ○ Fabric binding for Fibre Channel ○ Port security ○ Standard zoning ○ Domain and port zoning ○ Enhanced zoning ○ Cisco Fabric Analyzer ○ Fibre Channel traceroute ○ Fibre Channel ping ○ Fibre Channel debugging ○ Cisco Fabric Manager support ○ Storage Management Initiative Specification (SMI-S)

MDS 9000 24/10-Port SAN Extension Module specifications

Table 6 lists the specifications for the MDS 9000 24/10-Port SAN Extension Module.

Table 6. Product specifications for the MDS 9000 24/10-Port SAN Extension Module (part 1 of 5)

Feature	Description
Product compatibility	Cisco MDS 9000 Family
Software compatibility	Cisco MDS 9000 NX-OS Software 7.3(0)DY(1)
Protocols	Fibre Channel standards: <ul style="list-style-type: none"> ● FC-PH, Revision 4.3 (ANSI INCITS 230-1994) ● FC-PH, Amendment 1 (ANSI INCITS 230-1994/AM1-1996) ● FC-PH, Amendment 2 (ANSI INCITS 230-1994/AM2-1999) ● FC-PH-2, Revision 7.4 (ANSI INCITS 297-1997) ● FC-PH-3, Revision 9.4 (ANSI INCITS 303-1998) ● FC-PI, Revision 13 (ANSI INCITS 352-2002) ● FC-PI-2, Revision 10 (ANSI INCITS 404-2006) ● FC-PI-3, Revision 4 (ANSI INCITS 460-2011) ● FC-PI-4, Revision 8 (ANSI INCITS 450-2008) ● FC-PI-5, Revision 6 (ANSI INCITS 479-2011) ● FC-FS, Revision 1.9 (ANSI INCITS 373-2003) ● FC-FS-2, Revision 1.01 (ANSI INCITS 424-2007) ● FC-FS-2, Amendment 1 (ANSI INCITS 424-2007/AM1-2007) ● FC-FS-3, Revision 1.11 (ANSI INCITS 470-2011) ● FC-LS, Revision 1.62 (ANSI INCITS 433-2007) ● FC-LS-2, Revision 2.21 (ANSI INCITS 477-2011) ● FC-SW-2, Revision 5.3 (ANSI INCITS 355-2001) ● FC-SW-3, Revision 6.6 (ANSI INCITS 384-2004) ● FC-SW-4, Revision 7.5 (ANSI INCITS 418-2006) ● FC-SW-5, Revision 8.5 (ANSI INCITS 461-2010) ● FC-GS-3, Revision 7.01 (ANSI INCITS 348-2001) ● FC-GS-4, Revision 7.91 (ANSI INCITS 387-2004) ● FC-GS-5, Revision 8.51 (ANSI INCITS 427-2007) ● FC-GS-6, Revision 9.4 (ANSI INCITS 463-2010) ● FCP, Revision 12 (ANSI INCITS 269-1996) ● FCP-2, Revision 8 (ANSI INCITS 350-2003) ● FCP-3, Revision 4 (ANSI INCITS 416-2006) ● FCP-4, Revision 2b (ANSI INCITS 481-2011) ● FC-SB-2, Revision 2.1 (ANSI INCITS 349-2001) ● FC-SB-3, Revision 1.6 (ANSI INCITS 374-2003) ● FC-SB-3, Amendment 1 (ANSI INCITS 374-2003/AM1-2007) ● FC-SB-4, Revision 3.0 (ANSI INCITS 466-2011) ● FC-SB-5, Revision 2.00 (ANSI INCITS 485-2014) ● FC-BB-6, Revision 2.00 (ANSI INCITS 509-2014) ● FC-BB-2, Revision 6.0 (ANSI INCITS 372-2003) ● FC-BB-3, Revision 6.8 (ANSI INCITS 414-2006) ● FC-BB-4, Revision 2.7 (ANSI INCITS 419-2008) ● FC-BB-5, Revision 2.0 (ANSI INCITS 462-2010) ● FC-VI, Revision 1.84 (ANSI INCITS 357-2002) ● FC-SP, Revision 1.8 (ANSI INCITS 426-2007) ● FC-SP-2, Revision 2.71 (ANSI INCITS 496-2012) ● FAIS, Revision 1.03 (ANSI INCITS 432-2007) ● FAIS-2, Revision 2.23 (ANSI INCITS 449-2008) ● FC-IFR, Revision 1.06 (ANSI INCITS 475-2011) ● FC-FLA, Revision 2.7 (INCITS TR-20-1998) ● FC-PLDA, Revision 2.1 (INCITS TR-19-1998) ● FC-Tape, Revision 1.17 (INCITS TR-24-1999) ● FC-MI, Revision 1.92 (INCITS TR-30-2002) ● FC-MI-2, Revision 2.6 (INCITS TR-39-2005)

Table 6. Product specifications for the MDS 9000 24/10-Port SAN Extension Module (part 2 of 5)

Feature	Description
Protocols (cont.)	<ul style="list-style-type: none"> ● FC-MI-3, Revision 1.03 (INCITS TR-48-2012) ● FC-DA, Revision 3.1 (INCITS TR-36-2004) ● FC-DA-2, Revision 1.06 (INCITS TR-49-2012) ● FC-MSQS, Revision 3.2 (INCITS TR-46-2011) ● Fibre Channel classes of service: Class 2, Class 3, and Class F ● Fibre Channel standard port types: E, F, FL, and B ● Fibre Channel enhanced port types: SD, ST, and TE ● IP over Fibre Channel (RFC 2625) ● IPv6, IPv4, and Address Resolution Protocol (ARP) over Fibre Channel (RFC 4338) ● Extensive IETF-standards based TCP/IP, SNMPv3, and remote monitoring (RMON) MIBs <p>IP standards:</p> <ul style="list-style-type: none"> ● RFC 791 IPv4 ● RFC 793 and 1323 TCP ● RFC 894 IP/Ethernet ● RFC 1041 IP/802 ● RFC 792, 950, and 1256 Internet Control Message Protocol (ICMP) ● RFC 1323 TCP performance enhancements ● RFC 2338 Virtual Router Redundancy Protocol (VRRP) ● RFC 2460 and 4291 IPv6 ● RFC 2463 ICMPv6 ● RFC 2461 and 2462 IPv6 neighbor discovery and stateless autoconfiguration ● RFC 2464 IPv6/Ethernet ● RFC 3643 and 3821 FCIP <p>Ethernet standards:</p> <ul style="list-style-type: none"> ● IEEE 802.3z Gigabit Ethernet ● IEEE 802.1Q VLAN IPsec standards ● RFC 2401 Security Architecture for IP ● RFC 2403 and 2404 Hash Message Authentication Code (HMAC) ● RFC 2405, 2406, and 2451 IP Encapsulating Security Payload (ESP) ● RFC 2407 and 2408 Internet Security Association and Key Management Protocol (ISAKMP) ● RFC 2412 OAKLEY Key Determination Protocol ● RFC 3566, 3602, and 3686 AES <p>Internet Key Exchange (IKE) standards:</p> <ul style="list-style-type: none"> ● RFC 2409 IKEv1 ● IKEv2, draft
Cards, ports, and slots	24 x fixed 2/4/8/10/16-Gbps Fibre Channel ports, 8 x 1/10 Gigabit Ethernet ports
Features and Functions	
Fabric services	<ul style="list-style-type: none"> ● Name server ● Registered state change notification (RSCN) ● Login services ● Cisco Fabric Configuration Server (FCS) ● Private loop ● Public loop ● Translative loop ● Broadcast ● In-order delivery

Table 6. Product specifications for the MDS 9000 24/10-Port SAN Extension Module (part 3 of 5)

Feature	Description
Cards, ports, and slots	24 x fixed 2/4/8/10/16-Gbps Fibre Channel ports, 8 x 1/10 Gigabit Ethernet ports
Fabric services	<ul style="list-style-type: none"> ● Name server ● Registered state change notification (RSCN) ● Login services ● Cisco Fabric Configuration Server (FCS) ● Private loop ● Public loop ● Translative loop ● Broadcast ● In-order delivery
Advanced functions	<ul style="list-style-type: none"> ● VSAN ● IVR ● Port channel with multipath load balancing ● Flow-based and zone-based QoS ● Hardware-based compression for MAN and WAN data ● Hardware-based encryption ● Hardware-based data integrity ● FCIP disk write acceleration ● FCIP tape read and write acceleration
Diagnostics and troubleshooting tools	<ul style="list-style-type: none"> ● POST diagnostics ● Online diagnostics ● Internal port loopbacks ● SPAN and remote SPAN ● Fibre Channel Traceroute ● Fibre Channel Ping ● Fibre Channel Debug ● Cisco Fabric Analyzer ● Syslog ● Online system health ● Port-level statistics ● Real-Time Protocol (RTP) debug
Network security	<ul style="list-style-type: none"> ● VSANs ● ACLs ● Per-VSAN RBAC ● Fibre Channel zoning: <ul style="list-style-type: none"> ○ N-port worldwide name (WWN) ○ N-port FC-ID ○ Fx-port WWN ○ Fx-port WWN and interface index ○ Fx-port domain ID and interface index ○ Fx-port domain ID and port number ○ Logical unit number (LUN) ○ Read-only ○ Broadcast ● FC-SP: <ul style="list-style-type: none"> ○ DH-CHAP switch-to-switch authentication ○ DH-CHAP host-to-switch authentication ● Port security and fabric binding ● IPsec for FCIP ● IKEv1 and v2 ● Management access: <ul style="list-style-type: none"> ○ SSH v2 implementing AES ○ SNMPv3 implementing AES ○ SFTP

Table 6. Product specifications for the MDS 9000 24/10-Port SAN Extension Module (part 4 of 5)

Feature	Description
Serviceability	<ul style="list-style-type: none"> ● Configuration file management ● Nondisruptive software upgrades for Fibre Channel interfaces ● Call Home ● Power-management LEDs ● Port beaconing ● System LED ● SNMP traps for alerts ● Network boot
Performance	<ul style="list-style-type: none"> ● Port speed: Fibre Channel 2/4/8/10/16 Gbps, FCIP 1/10/40 Gigabit Ethernet ● Port channels: Up to 16 FCIP links ● FCIP tunnels: Up to 4 per port
Reliability and availability	<ul style="list-style-type: none"> ● Hot-swappable module ● Hot-swappable SFP optics ● Online diagnostics ● Stateful process restart ● Nondisruptive supervisor failover ● Any module, any port configuration for port channels ● Fabric-based multipathing ● Per-VSAN fabric services ● Port tracking ● VRRP for management and FCIP
Network management	<ul style="list-style-type: none"> ● Access methods through Cisco MDS 9700 Series Supervisor Module: <ul style="list-style-type: none"> ○ Out-of-band 10/100/1000 Ethernet port (Supervisor-1 Module) ○ Out-of-band 10/100/1000 Ethernet port (Supervisor-2 Module) ○ RS-232 serial console port (RJ45 form factor) ○ In-band IP-over-Fibre Channel ● Access protocols: <ul style="list-style-type: none"> ○ Command-line interface (CLI) through console and Ethernet ports ○ SNMPv3 through Ethernet port and in-band IP-over-Fibre Channel access ○ Storage Networking Industry Association (SNIA) Storage Management Initiative Specification (SMI-S) ● Distributed device alias service ● Network security: <ul style="list-style-type: none"> ○ Per-VSAN RBAC using RADIUS- and TACACS+-based authentication, authorization, and accounting (AAA) functions ○ SFTP ○ SSHv2 implementing AES ○ SNMPv3 implementing AES ● Management applications: <ul style="list-style-type: none"> ○ Cisco MDS 9000 Family CLI ○ Cisco Data Center Network Manager ○ Cisco Device Manager
Programming interfaces	<ul style="list-style-type: none"> ● Cisco Fabric Manager GUI ● Cisco Device Manager GUI
Environmental	<ul style="list-style-type: none"> ● Temperature, ambient operating: 32 - 104°F (0 - 40°C) ● Temperature, ambient nonoperating and storage: -40 - 158°F (-40 - 70°C) ● Relative humidity, ambient (noncondensing) operating: 5 - 90% ● Relative humidity, ambient (noncondensing) nonoperating and storage: 5 - 95% ● Altitude, operating: -197 - 6500 ft (-60 - 2000m)
Physical dimensions	<ul style="list-style-type: none"> ● Dimensions (H x W x D): 4.4 x 40.39 x 55.37 cm (1.75 x 15.9 x 21.8 in.) Occupies one slot in a Cisco MDS 9700 Series ● Weight: 7.71 kg (17 lb)

Table 6. Product specifications for the MDS 9000 24/10-Port SAN Extension Module (part 5 of 5)

Feature	Description
Approvals and compliance	<p>Safety compliance:</p> <ul style="list-style-type: none"> ● CE Marking ● UL 60950 ● CAN/CSA-C22.2 No. 60950 ● EN 60950 ● IEC 60950 ● TS 001 ● AS/NZS 3260 ● IEC60825 ● EN60825 ● 21 CFR 1040 <p>EMC compliance:</p> <ul style="list-style-type: none"> ● FCC Part 15 (CFR 47) Class A ● ICES-003 Class A ● EN 55022 Class A ● CISPR 22 Class A ● AS/NZS 3548 Class A ● VCCI Class A ● EN 55024 ● EN 50082-1 ● EN 61000-6-1 ● EN 61000-3-2 ● EN 61000-3-3

Specifications for the MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module

Table 7 lists the specifications for the MDS 9700 48-Port 32-Gbps Fibre Channel Switching Modules.

Table 7. Specifications for the MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module (Part 1 of 5)

Item	Description
Product compatibility	Cisco MDS 9700 Series Multilayer Directors
Software compatibility	Cisco MDS 9000 NX-OS Software Release NX-OS 8.1(1)
Protocols	<ul style="list-style-type: none"> ● Fibre Channel standards: <ul style="list-style-type: none"> ○ FC-PH, Revision 4.3 (ANSI INCITS 230-1994) ○ FC-PH, Amendment 1 (ANSI INCITS 230-1994/AM1-1996) ○ FC-PH, Amendment 2 (ANSI INCITS 230-1994/AM2-1999) ○ FC-PH-2, Revision 7.4 (ANSI INCITS 297-1997) ○ FC-PH-3, Revision 9.4 (ANSI INCITS 303-1998) ○ FC-PI, Revision 13 (ANSI INCITS 352-2002) ○ FC-PI-2, Revision 10 (ANSI INCITS 404-2006) ○ FC-PI-3, Revision 4 (ANSI INCITS 460-2011) ○ FC-PI-4, Revision 8 (ANSI INCITS 450-2008) ○ FC-PI-5, Revision 6 (ANSI INCITS 479-2011) ○ FC-FS, Revision 1.9 (ANSI INCITS 373-2003) ○ FC-FS-2, Revision 1.01 (ANSI INCITS 424-2007) ○ FC-FS-2, Amendment 1 (ANSI INCITS 424-2007/AM1-2007) ○ FC-FS-3, Revision 1.11 (ANSI INCITS 470-2011) ○ FC-LS, Revision 1.62 (ANSI INCITS 433-2007)

Table 7. Specifications for the MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module (Part 2 of 5)

Item	Description
Protocols (continued)	<ul style="list-style-type: none"> ● Fibre Channel standards (continued): <ul style="list-style-type: none"> ○ FC-LS-2, Revision 2.21 (ANSI INCITS 477-2011) ○ FC-SW-2, Revision 5.3 (ANSI INCITS 355-2001) ○ FC-SW-3, Revision 6.6 (ANSI INCITS 384-2004) ○ FC-SW-4, Revision 7.5 (ANSI INCITS 418-2006) ○ FC-SW-5, Revision 8.5 (ANSI INCITS 461-2010) ○ FC-GS-3, Revision 7.01 (ANSI INCITS 348-2001) ○ FC-GS-4, Revision 7.91 (ANSI INCITS 387-2004) ○ FC-GS-5, Revision 8.51 (ANSI INCITS 427-2007) ○ FC-GS-6, Revision 9.4 (ANSI INCITS 463-2010) ○ FCP, Revision 12 (ANSI INCITS 269-1996) ○ FCP-2, Revision 8 (ANSI INCITS 350-2003) ○ FCP-3, Revision 4 (ANSI INCITS 416-2006) ○ FCP-4, Revision 2b (ANSI INCITS 481-2011) ○ FC-SB-2, Revision 2.1 (ANSI INCITS 349-2001) ○ FC-SB-3, Revision 1.6 (ANSI INCITS 374-2003) ○ FC-SB-3, Amendment 1 (ANSI INCITS 374-2003/AM1-2007) ○ FC-SB-4, Revision 3.0 (ANSI INCITS 466-2011) ○ FC-SB-5, Revision 2.00 (ANSI INCITS 485-2014) ○ FC-BB-6, Revision 2.00 (ANSI INCITS 509-2014) ○ FC-BB-2, Revision 6.0 (ANSI INCITS 372-2003) ○ FC-BB-3, Revision 6.8 (ANSI INCITS 414-2006) ○ FC-BB-4, Revision 2.7 (ANSI INCITS 419-2008) ○ FC-BB-5, Revision 2.0 (ANSI INCITS 462-2010) ○ FC-VI, Revision 1.84 (ANSI INCITS 357-2002) ○ FC-SP, Revision 1.8 (ANSI INCITS 426-2007) ○ FC-SP-2, Revision 2.71 (ANSI INCITS 496-2012) ○ FAIS, Revision 1.03 (ANSI INCITS 432-2007) ○ FAIS-2, Revision 2.23 (ANSI INCITS 449-2008) ○ FC-IFR, Revision 1.06 (ANSI INCITS 475-2011) ○ FC-FLA, Revision 2.7 (INCITS TR-20-1998) ○ FC-PLDA, Revision 2.1 (INCITS TR-19-1998) ○ FC-Tape, Revision 1.17 (INCITS TR-24-1999) ○ FC-MI, Revision 1.92 (INCITS TR-30-2002) ○ FC-MI-2, Revision 2.6 (INCITS TR-39-2005) ○ FC-MI-3, Revision 1.03 (INCITS TR-48-2012) ○ FC-DA, Revision 3.1 (INCITS TR-36-2004) ○ FC-DA-2, Revision 1.06 (INCITS TR-49-2012) ○ FC-MSQS, Revision 3.2 (INCITS TR-46-2011) ● Fibre Channel classes of service: Class 2, Class 3, and Class F ● Fibre Channel standard port types: E, F, FL, and B ● Fibre Channel enhanced port types: SD, ST, and TE
Cards, ports, and slots	<ul style="list-style-type: none"> ● 48 autosensing 4/8-Gbps or 4/8/16-Gbps or 8/16/32-Gbps Fibre Channel ports ● Can be used on any payload slot of the MDS 9700 Series directors
Features and functions	
Fabric services	Name server: <ul style="list-style-type: none"> ● Registered state-change notification (RSCN) ● Login services ● Fabric configuration server (FCS) ● Public loop ● Broadcast ● In-order delivery

Table 7. Specifications for the MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module (Part 3 of 5)

Item	Description
Advanced functions	<ul style="list-style-type: none"> ● VSAN ● IVR ● Port channel with multipath load balancing ● Flow-based and zone-based QoS ● N-port ID virtualization (NPIV) ● Inline analytics
Diagnostics and troubleshooting tools	<ul style="list-style-type: none"> ● POST diagnostics ● Online diagnostics ● Internal port loopbacks ● SPAN and RSPAN ● Fibre Channel traceroute ● Fibre Channel ping ● Fibre Channel debug ● Cisco Fabric Analyzer ● Syslog ● Online system health ● Port-level statistics ● Real-time protocol debug ● E-port and F-port diagnostics
Network security	<ul style="list-style-type: none"> ● VSANs ● ACLs ● Per-VSAN RBAC ● Fibre Channel zoning: <ul style="list-style-type: none"> ○ N-port Worldwide Name (WWN) ○ N-port Fibre Channel ID (FC-ID) ○ Fx-port WWN ○ Fx-port WWN and interface index ○ Fx-port domain ID and interface index ○ Fx-port domain ID and port number ○ LUN ● FC-SP:^a <ul style="list-style-type: none"> ○ DH-CHAP switch-to-switch authentication ○ DH-CHAP host-to-switch authentication ● Port security and fabric binding ● Management access: <ul style="list-style-type: none"> ○ SSHv2 implementing AES ○ SNMPv3 implementing AES ○ SFTP ● Cisco TrustSec1Fibre Channel link-level encryption: <ul style="list-style-type: none"> ○ SSHv2 implementing AES
Serviceability	<ul style="list-style-type: none"> ● Configuration file management ● Nondisruptive software upgrades for Fibre Channel interfaces ● Cisco Call Home ● Power-management LEDs ● Port beaconing ● System LED ● SNMP traps for alerts ● Network boot

a. Supported only for 4- and 8-Gbps speeds. 2 Gbps is not supported.

Table 7. Specifications for the MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module (Part 4 of 5)

Item	Description
Performance	<ul style="list-style-type: none"> ● Port speed: 4/8-Gbps, 4/8/16-Gbps, and 8/16/32-Gbps autosensing Fibre Channel ● Buffer credits: <ul style="list-style-type: none"> ○ Default credits per port: 500 ○ With Enterprise license: <ul style="list-style-type: none"> ● 8300 shared among a single port group of 16 ports ● 8191 maximum credits per port Port channel: Up to 16 ports ● Port channel: Up to 16 ports
Reliability and availability	<ul style="list-style-type: none"> ● Hot-swappable module ● Hot-swappable SFP+ transceivers ● Online diagnostics ● Stateful process restart ● Nondisruptive supervisor failover ● Any-module, any-port configuration for port channels ● Fabric-based multipathing ● Per-VSAN fabric services ● Port tracking ● Virtual Routing Redundancy Protocol (VRRP) for management
Network management	<ul style="list-style-type: none"> ● Access methods through MDS 9700 Series Supervisor-1 Module: <ul style="list-style-type: none"> ○ Out-of-band 10/100/1000 Ethernet port (Supervisor-1) ○ RS-232 serial console port ○ In-band IP over Fibre Channel ● Access methods through MDS 9700 Series Fibre Channel switching module: <ul style="list-style-type: none"> ○ In-band FICON Control Unit Port (CUP) over any IBM System Z FICON channel ● Access protocols: <ul style="list-style-type: none"> ○ Command-line interface (CLI) through console and Ethernet ports ○ SNMPv3 through Ethernet port and in-band IP over Fibre Channel access ○ FICON CUP ● Distributed Device Alias service ● Network security: <ul style="list-style-type: none"> ○ Per-VSAN RBAC using RADIUS- and TACACS+-based authentication, authorization, and accounting (AAA) functions ○ SFTP ○ SSHv2 implementing AES ○ SNMPv3 implementing AES ● Management applications: <ul style="list-style-type: none"> ○ Cisco MDS 9000 Family CLI ○ Cisco Fabric Manager ○ Cisco Device Manager
Programming interfaces	<ul style="list-style-type: none"> ● Scriptable CLI ● Cisco Prime DCNM web services API ● Cisco Prime DCNM GUI ● Representational state transfer (REST) API
Environmental	<ul style="list-style-type: none"> ● Temperature, ambient operating: 0 - 40°C (32 - 104°F) ● Temperature, ambient nonoperating and storage: -40 - 70°C (-40 - 158°F) ● Relative humidity, ambient (noncondensing) operating: 10 - 90% ● Relative humidity, ambient (noncondensing) nonoperating and storage: 10 - 95% ● Altitude, operating: -60 - 2000m (-197 - 6500 ft)
Physical dimensions	<ul style="list-style-type: none"> ● Dimensions (H x W x D): 4.4 x 40.39 x 55.37 cm (1.75 x 15.9 x 21.8 in.) ● Weight: 7.94 kg (17.5 lb)

Table 7. Specifications for the MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module (Part 5 of 5)

Item	Description
Approvals and compliance	<ul style="list-style-type: none"> ● Regulatory compliance: <ul style="list-style-type: none"> ○ CE Markings per directives 2004/108/EC and 2006/95/EC ● Safety compliance: <ul style="list-style-type: none"> ○ UL 60950-1 Second Edition ○ CAN/CSA-C22.2 No. 60950-1 Second Edition ○ EN 60950-1 Second Edition ○ IEC 60950-1 Second Edition ○ AS/NZS 60950-1 ○ GB4943 2001 ● EMC compliance: <ul style="list-style-type: none"> ○ 47CFR Part 15 (CFR 47) Class A ○ AS/NZS CISPR22 Class A ○ CISPR22 Class A ○ EN55022 Class A ○ ICES003 Class A ○ VCCI Class A ○ EN61000-3-2 ○ EN61000-3-3 ○ KN22 Class A ○ CNS13438 Class A ○ EN55024 ○ CISPR24 ○ EN300386 ○ KN24

Table 8 lists supported Cisco optics, media, and transmission distances.

Table 8. Supported Cisco optics, media, and transmission distances.

Speed	Media	Distance
<ul style="list-style-type: none"> ● 32-Gbps shortwave LC, SFP+ ● 32-Gbps longwave, LC, SFP+ ● 16-Gbps shortwave, LC, SFP+ ● 16-Gbps longwave, LC, SFP+ ● 8-Gbps shortwave, LC, SFP+ ● 8-Gbps longwave, LC, SFP+ 	<ul style="list-style-type: none"> ● 50/125-micron multimode ● 9/125-micron single mode ● 50/125-micron multimode ● 9/125-micron single mode ● 50/125-micron multimode ● 9/125-micron single mode 	<ul style="list-style-type: none"> ● 70 m OM3 and 100 m OM4 ● 10 km ● 100 m OM3 and 125 m OM4 ● 10 km ● 150m OM3 and 190 m ● OM4 10 km

Cisco MDS 9700 Series 48-port 16Gbps Fibre Channel Switching Module

Table 9 lists the product specifications for the Cisco MDS 9700 Series 48-port 16-Gbps Fibre Channel Switching Module.

Table 9. Product specifications for the Cisco MDS 9700 Series 48-port 16-Gbps Fibre Channel Switching Module (part 1 of 3)

Feature	Description
Product compatibility	Cisco MDS 9700 Series
Software compatibility	Cisco MDS NX-OS Software Release 6.2.3 or later. NX-OS 6.2.5 is recommended.
Cards, ports, and slots	<ul style="list-style-type: none"> ● 48 autosensing 2/4/8 Gbps or 4/8/16 Gbps Fibre Channel ports ● 48 autosensing 10 Gbps Fibre Channel ports

Table 9. Product specifications for the Cisco MDS 9700 Series 48-port 16-Gbps Fibre Channel Switching Module (part 2 of 3)

Feature	Description
Fabric services	<ul style="list-style-type: none"> ● Name server ● Registered State Change Notification (RSCN) ● Login services ● Fabric Configuration Server (FCS) ● Public loop ● Broadcast ● In-order delivery
Advanced functions	<ul style="list-style-type: none"> ● VSAN ● IVR ● PortChannel with Multipath Load Balancing ● Flow-based and zone-based QoS ● NPIV ● Local switching with centralized arbitration
Diagnostic and troubleshooting tools	<ul style="list-style-type: none"> ● POST diagnostic tests ● Online diagnostic tests ● Internal port loopbacks ● SPAN and RSPAN ● Fibre Channel Traceroute ● Fibre Channel Ping ● Fibre Channel Debug ● Cisco Fabric Analyzer ● Syslog ● Online system health ● Port-level statistics ● Real-Time Protocol Debug
Network security	<ul style="list-style-type: none"> ● VSANs ● ACLs ● Per-VSAN RBAC ● Fibre Channel zoning: <ul style="list-style-type: none"> ○ N-port Worldwide Name (WWN) ○ N-port Fibre Channel ID (FC-ID) ○ Fx-port WWN ○ Fx-port WWN and interface index ○ Fx-port domain ID and interface index ○ Fx-port domain ID and port number ○ Logical unit number (LUN) ● FC-SP: <ul style="list-style-type: none"> ○ Diffie-Hellman Challenge Handshake Authentication Protocol (DH-CHAP) switch-to-switch authentication ○ DH-CHAP host-to-switch authentication ● Port Security and Fabric Binding ● Management access: <ul style="list-style-type: none"> ○ SSHv2 implementing AES ○ SNMPv3 implementing AES ○ SFTP
Serviceability	<ul style="list-style-type: none"> ● Configuration file management ● Nondisruptive software upgrades for Fibre Channel interfaces ● Call Home ● Power-management LEDs ● Port beaconing ● System LED ● SNMP traps for alerts ● Network boot

Table 9. Product specifications for the Cisco MDS 9700 Series 48-port 16-Gbps Fibre Channel Switching Module (part 3 of 3)

Feature	Description
Performance	<ul style="list-style-type: none"> ● Port speed: 2/4/8/16 Gbps autosensing, optionally configurable for 10 Gbps Fibre Channel ● Buffer credits: Up to 500 per port and up to 4095 on an individual port (with optional Enterprise Package license activated) ● PortChannel: Up to 16 ports
Reliability and availability	<ul style="list-style-type: none"> ● Hot-swappable module ● Hot-swappable SFP/SFP+ transceivers ● Online diagnostic tests ● Stateful Process Restart ● Nondisruptive Supervisor Failover ● Any module, any port configuration for PortChannels ● Fabric-based multipathing ● Per-VSAN fabric services ● Port Tracking ● Virtual Routing Redundancy Protocol (VRRP) for management
Network management	<ul style="list-style-type: none"> ● Access methods through Cisco MDS 9700 Series Supervisor module: <ul style="list-style-type: none"> ○ Out-of-band 10/100 Ethernet port (Supervisor-1) ○ Out-of-band 10/100/1000 Ethernet port (Supervisor-1) ○ RS-232 serial console port ○ In-band IP over Fibre Channel ● Access protocols: <ul style="list-style-type: none"> ○ CLI through console and Ethernet ports ○ SNMPv3 through Ethernet port and in-band IP over Fibre Channel access ● Distributed Device Alias service ● Network security: <ul style="list-style-type: none"> ○ Per-VSAN RBAC by using RADIUS- and TACACS+-based authentication, authorization, and accounting (AAA) functions ○ SFTP ○ SSHv2 implementing AES ○ SNMPv3 implementing AES ● Management applications: <ul style="list-style-type: none"> ○ Cisco MDS 9000 Family CLI ○ Cisco Fabric Manager ○ Cisco Device Manager ○ CiscoWorks Resource Manager Essentials (RME) and Device Fault Manager (DFM)
Programming interfaces	<ul style="list-style-type: none"> ● Scriptable CLI ● Cisco DCNM-SAN Essentials ● Cisco DCNM-SAN Advanced
Physical dimensions	<ul style="list-style-type: none"> ● Dimensions (H x W x D): 4.4 x 40.39 x 55.37 cm (1.75 x 15.9 x 21.8 in.) ● Weight: 7.71 kg (17 lbs)

Table 10 lists the product specifications for the Cisco MDS 9700 Series 48-port 10-Gbps FCoE Switching Module.

Table 10. Product specifications for the Cisco MDS 9700 Series 48-port 10-Gbps FCoE Switching Module (Part 1 of 4)

Feature	Description
Product compatibility	Cisco MDS 9700 Series Multilayer Directors
Software compatibility	Requires Cisco MDS NX-OS Release 6.2(7) or later

Table 10. Product specifications for the Cisco MDS 9700 Series 48-port 10-Gbps FCoE Switching Module (Part 2 of 4)

Feature	Description
Ports	48 fixed autosensing 10 Gbps FCoE ports
Slots	Can be used on any payload slot of the MDS 9700 Series directors
Fabric services	<ul style="list-style-type: none"> ● Name server ● RSCN ● Login services ● Cisco Fabric Configuration Server (FCS) ● Public loop ● Broadcast ● In-order delivery
Advanced capabilities	<ul style="list-style-type: none"> ● VSAN ● PortChannel with multipath load balancing ● QoS: Flow based and zone based
Diagnostic and troubleshooting tools	<ul style="list-style-type: none"> ● POST diagnostic tests ● Online diagnostic tests ● Fibre Channel ping ● Fibre Channel debug ● Cisco Fabric Analyzer ● Syslog ● Online system health ● Port-level statistics ● Real-Time Transport Protocol (RTP) debug ● Online Health Monitoring System (OHMS) or Cisco Generic Online Diagnostics (GOLD) ● Enhanced Small Form-Factor Pluggable (SFP+) digital diagnostic tests
Security	<ul style="list-style-type: none"> ● VSANs ● ACLs ● Per-VSAN role-based access control (RBAC) ● Fibre Channel zoning ● Port security and fabric binding ● Cisco Switched Port Analyzer (SPAN) ● Management access: <ul style="list-style-type: none"> ○ Secure Shell (SSH) Protocol Version 2 (v2) implementing Advanced Encryption Standard (AES) ○ Simple Network Management Protocol (SNMP) Version 3 implementing AES ○ Secure FTP (SFTP)
Serviceability	<ul style="list-style-type: none"> ● Nondisruptive, concurrent code load and activation ● Configuration file management ● Nondisruptive software upgrades ● Cisco Call Home ● Power-management LEDs ● Port beaconing ● System LED ● SNMP traps for alerts ● Network boot
Performance	<ul style="list-style-type: none"> ● Port speed: 10 Gbps fixed bandwidth ● PortChannel: Up to 16 ports

Table 10. Product specifications for the Cisco MDS 9700 Series 48-port 10-Gbps FCoE Switching Module (Part 3 of 4)

Feature	Description
Reliability and availability	<ul style="list-style-type: none"> ● Hot-swappable module ● Hot-swappable SFP optics ● Online diagnostic tests ● Stateful process restart ● Nondisruptive supervisor failover ● Any module, any port configuration for PortChannels ● Fabric-based multipathing ● Per-VSAN fabric services ● Port tracking
Network management	<ul style="list-style-type: none"> ● Access methods through Cisco MDS 9700 Series supervisor module: <ul style="list-style-type: none"> ○ Out-of-band 10/100/1000 Ethernet port (Supervisor-2A) ○ RS-232 serial console port ○ In-band IPFC ○ DB-9 COM port ● Access protocols: <ul style="list-style-type: none"> ○ Command-line interface (CLI) by console and Ethernet ports ○ SNMPv3 by Ethernet port and in-band IPFC access ○ Storage Networking Industry Association (SNIA) SMI-S ● Network security: <ul style="list-style-type: none"> ○ Per-VSAN RBAC by using RADIUS-based and TACACS+-based authentication, authorization, and accounting (AAA) functions ○ SFTP ○ SSHv2 implementing AES ○ SNMPv3 implementing AES ● Management applications: <ul style="list-style-type: none"> ○ Cisco MDS 9000 Family CLI ○ Cisco Data Center Network Manager (DCNM) for SAN ○ Cisco Device Manager ○ CiscoWorks Resource Manager Essentials (RME) and Device Fault Manager (DFM)
Programming interfaces	<ul style="list-style-type: none"> ● Scriptable CLI ● Cisco DCNM for SAN GUI ● Cisco Device Manager GUI
Environmental	<ul style="list-style-type: none"> ● Temperature, ambient operating: 0 - 40°C (32 - 104°F) ● Temperature, ambient nonoperating and storage: -40 - 70°C (-40 - 158°F) ● Relative humidity, ambient (noncondensing) operating: 5 - 90% ● Relative humidity, ambient (noncondensing) nonoperating and storage: 5 - 95% ● Altitude, operating: -60 - 2000 m (-197 - 6500 ft)

Table 10. Product specifications for the Cisco MDS 9700 Series 48-port 10-Gbps FCoE Switching Module (Part 4 of 4)

Feature	Description
Physical dimensions	<ul style="list-style-type: none"> ● Dimensions (H x W x D): 4.4 x 40.39 x 55.37 cm (1.75 x 15.9 x 21.8 in.) ● Occupies one slot in a Cisco MDS 9700 Series chassis ● Weight: 7.7 kg (17.0 lb)
Power	Typical: 400 watts (W)
Approvals and compliance	<ul style="list-style-type: none"> ● Safety compliance: <ul style="list-style-type: none"> ○ CE marking ○ UL 60950 ○ CAN/CSA-C22.2 No. 60950 ○ EN 60950 ○ IEC 60950 ○ TS 001 ○ AS/NZS 3260 ○ IEC60825 ○ EN60825 ○ 21 CFR 1040 ● EMC compliance: <ul style="list-style-type: none"> ○ FCC Part 15 (CFR 47) Class A ○ ICES-003 Class A ○ EN 55022 Class A ○ CISPR 22 Class A ○ AS/NZS 3548 Class A ○ VCCI Class A ○ KN22 Class A ○ CNS13438 Class A ○ CISPR24 ○ EN 55024 ○ EN 50082-1 ○ EN 61000-6-1 ○ EN 61000-3-2 ○ EN 61000-3-3 ○ EN300 386

Table 11 lists the product specifications for the Cisco MDS 9700 Series 24-port 40-Gbps FCoE Switching Module.

Table 11. Product specifications for the Cisco MDS 9700 Series 24-port 40-Gbps FCoE Switching Module (Part 1 of 5)

Feature	Description
Product compatibility	Cisco MDS 9700 Series Multilayer Directors
Software compatibility	Requires Cisco MDS 9000 NX-OS Software Release 7.3.0.D1.1 or later
Fibre Channel and FCoE protocols	<ul style="list-style-type: none"> ● Fibre Channel standards: <ul style="list-style-type: none"> ○ FC-BB-5, Revision 2.0 (ANSI INCITS 462-2010) ○ FC-BB-4, Revision 2.7 (ANSI INCITS 419-2008) ○ FC-BB-3, Revision 6.8 (ANSI INCITS 414-2006) ○ FC-BB-2, Revision 6.0 (ANSI INCITS 372-2003) ○ FC-FS-3, Revision 1.11 (ANSI INCITS 470-2011) ○ FC-FS-2, Revision 1.01 (ANSI INCITS 424-2007) ○ FC-FS-2, Amendment 1 (ANSI INCITS 424-2007/AM1-2007) ○ FC-FS, Revision 1.9 (ANSI INCITS 373-2003) ○ FC-LS-2, Revision 2.21 (ANSI INCITS 477-2011) ○ FC-LS, Revision 1.62 (ANSI INCITS 433-2007) ○ FC-SW-5, Revision 8.5 (ANSI INCITS 461-2010) ○ FC-SW-4, Revision 7.5 (ANSI INCITS 418-2006) ○ FC-SW-3, Revision 6.6 (ANSI INCITS 384-2004) ○ FC-SW-2, Revision 5.3 (ANSI INCITS 355-2001) ○ FC-GS-6, Revision 9.4 (ANSI INCITS 463-2010) ○ FC-GS-5, Revision 8.51 (ANSI INCITS 427-2007) ○ FC-GS-4, Revision 7.91 (ANSI INCITS 387-2004) ○ FC-GS-3, Revision 7.01 (ANSI INCITS 348-2001) ○ FCP-4, Revision 2 ○ FCP-3, Revision 4 (ANSI INCITS 416-2006) ○ FCP-2, Revision 8 (ANSI INCITS 350-2003) ○ FCP, Revision 12 (ANSI INCITS 269-1996) ○ FC-SB-4, Revision 3.0 (ANSI INCITS 466-2011) ○ FC-SB-3, Revision 1.6 (ANSI INCITS 374-2003) ○ FC-SB-3, Amendment 1 (ANSI INCITS 374-2003/AM1-2007) ○ FC-SB-2, Revision 2.1 (ANSI INCITS 349-2001) ○ FC-VI, Revision 1.84 (ANSI INCITS 357-2002) ○ FC-SP, Revision 1.8 (ANSI INCITS 426-2007) ○ FAIS-2, Revision 2.23 (ANSI INCITS 449-2008) ○ FAIS, Revision 1.03 (ANSI INCITS 432-2007) ○ FC-IFR, Revision 1.06 (ANSI INCITS 475-2011) ○ FC-MI-2, Revision 2.6 (INCITS TR-39-2005) ○ FC-MI, Revision 1.92 (INCITS TR-30-2002) ○ FC-DA, Revision 3.1 (INCITS TR-36-2004) ○ FC-FLA, Revision 2.7 (INCITS TR-20-1998) ○ FC-PLDA, Revision 2.1 (INCITS TR-19-1998) ○ FC-Tape, Revision 1.17 (INCITS TR-24-1999)

Table 11. Product specifications for the Cisco MDS 9700 Series 24-port 40-Gbps FCoE Switching Module (Part 2 of 5)

Feature	Description
Fibre Channel and FCoE protocols (cont.)	<ul style="list-style-type: none"> ● Fibre Channel features: <ul style="list-style-type: none"> ○ T11 standards-compliant FCoE ○ T11 FCoE Initialization Protocol (FIP) ○ FCoE forwarder (FCF) ○ Multihop FCoE with virtual Ethernet (VE) port support ○ Converged Enhanced Ethernet (CEE) interoperability ○ Direct attachment of FCoE targets ○ Class of service: Classes 2, 3, and F ○ Fibre Channel enhanced port types: VE, TE, and VF ○ F-port trunking ○ F-port channeling ○ VSANs ○ Fibre Channel port channel ○ VSAN trunking ○ Fabric Device Management Interface (FDMI) ○ Fibre Channel ID (FCID) persistence ○ Distributed device alias services ○ In-order delivery ○ Port tracking ○ N-port virtualization (NPV) ○ N-port ID virtualization (NPIV) ○ Fabric services: Name server, registered state change notification (RSCN), login services, and name-server zoning ○ Per-VSAN fabric services ○ Cisco Fabric Services ○ Fabric Shortest Path First (FSPF) ○ Diffie-Hellman Challenge Handshake Authentication Protocol (DH-CHAP) and Fibre Channel Security Protocol (FC-SP) ○ Host-to-switch and switch-to-switch FC-SP authentication ○ Fabric binding for Fibre Channel ○ Port security ○ Standard zoning ○ Domain and port zoning ○ Enhanced zoning ○ Cisco Fabric Analyzer ○ Fibre Channel traceroute ○ Fibre Channel ping ○ Fibre Channel debugging ○ Cisco Fabric Manager support ○ Storage Management Initiative Specification (SMI-S)
Ethernet protocols	<ul style="list-style-type: none"> ● IEEE 802.3, Carrier Sense Multiple Access/Collision Detect (CSMA/CD) access method and physical layer (phy) specifications ● IEEE 802.1Q, MAC address bridges and virtual bridged LANs ● IEEE 802.1Qbb, priority-based flow control (PFC) ● IEEE 802.1Qaz, enhanced transmission selection (ETS) ● IEEE 802.1Qaz, Data Center Bridging Exchange (DCBX) Protocol
Ports	24 fixed autosensing 40 Gbps FCoE ports
Slots	<ul style="list-style-type: none"> ● Can be used on any payload slot of the MDS 9700 Series directors

Table 11. Product specifications for the Cisco MDS 9700 Series 24-port 40-Gbps FCoE Switching Module (Part 3 of 5)

Feature	Description
Fabric services	<ul style="list-style-type: none"> ● Name server ● RSCN ● Login services ● Cisco Fabric Configuration Server (FCS) ● Public loop ● Broadcast ● In-order delivery
Advanced capabilities	<ul style="list-style-type: none"> ● VSAN ● Port channel with multipath load balancing ● QoS: Flow based and zone based
Diagnostics and troubleshooting tools	<ul style="list-style-type: none"> ● Power-on self-test (POST) diagnostics ● Online diagnostics ● Fibre Channel ping ● Fibre Channel debug ● Cisco Fabric Analyzer ● FCoE to FCoE SPAN ● Syslog ● Port-level statistics ● Cisco Generic Online Diagnostics (GOLD)
Security	<ul style="list-style-type: none"> ● VSANs ● ACLs ● Per-VSAN role-based access control (RBAC) ● Fibre Channel zoning ● Port security and fabric binding ● Cisco Switched Port Analyzer (SPAN) ● Management access: <ul style="list-style-type: none"> ○ Secure Shell (SSH) Protocol Version 2 (v2) implementing Advanced Encryption Standard (AES) ○ Simple Network Management Protocol (SNMP) Version 3 implementing AES ○ Secure FTP (SFTP)
Serviceability	<ul style="list-style-type: none"> ● Nondisruptive, concurrent code load and activation ● Configuration file management ● Nondisruptive software upgrades ● Cisco Call Home ● Power-management LEDs ● Port beaconing ● System LED ● SNMP traps for alerts ● Network boot
Performance	<ul style="list-style-type: none"> ● Port speed: 40 Gbps fixed bandwidth ● PortChannel: Up to 16 ports
Reliability and availability	<ul style="list-style-type: none"> ● Hot-swappable module ● Hot-swappable Small Form-Factor Pluggable (SFP) optics ● Online diagnostics ● Stateful process restart ● Nondisruptive supervisor failover ● Any module, any port configuration for port channels ● Fabric-based multipathing ● Per-VSAN fabric services ● Port tracking

Table 11. Product specifications for the Cisco MDS 9700 Series 24-port 40-Gbps FCoE Switching Module (Part 4 of 5)

Feature	Description
Network management	<ul style="list-style-type: none"> ● Access methods through Cisco MDS 9700 Series supervisor module: <ul style="list-style-type: none"> ○ Out-of-band 10/100/1000 Ethernet port (Supervisor-1/Supervisor-1E) ○ RS-232 serial console port ○ In-band IPFC ○ DB-9 COM port ● Access protocols: <ul style="list-style-type: none"> ○ Command-line interface (CLI) by console and Ethernet ports ○ SNMPv3 by Ethernet port and in-band IPFC access ○ Storage Networking Industry Association (SNIA) SMI-S ● Network security: <ul style="list-style-type: none"> ○ Per-VSAN RBAC by using RADIUS-based and TACACS+-based authentication, authorization, and accounting (AAA) functions ○ SFTP ○ SSHv2 implementing AES ○ SNMPv3 implementing AES ● Management applications: <ul style="list-style-type: none"> ○ Cisco MDS 9000 Family CLI ○ Cisco Data Center Network Manager (DCNM) for SAN ○ Cisco Device Manager ○ CiscoWorks Resource Manager Essentials (RME) and Device Fault Manager (DFM)
Programming interfaces	<ul style="list-style-type: none"> ● Scriptable CLI ● Cisco DCNM for SAN GUI ● Cisco Device Manager GUI ● NX-API
Environmental	<ul style="list-style-type: none"> ● Temperature, ambient operating: 0 - 40°C (32 - 104°F) ● Temperature, ambient nonoperating and storage: -40 - 70°C (-40 - 158°F) ● Relative humidity, ambient (noncondensing) operating: 5 - 90% ● Relative humidity, ambient (noncondensing) nonoperating and storage: 5 - 95% ● Altitude, operating: -60 - 2000 m (-197 - 6500 ft)
Physical dimensions	<ul style="list-style-type: none"> ● Dimensions: 4.4 x 40.39 x 55.37 cm (1.75 x 15.9 x 21.8 in.) ● Occupies one I/O module slot in a Cisco MDS 9700 Series chassis ● Weight: 7.7 kg (17 lb)
Power	Typical: 680 watts (W)

Table 11. Product specifications for the Cisco MDS 9700 Series 24-port 40-Gbps FCoE Switching Module (Part 5 of 5)

Feature	Description
Approvals and compliance	<ul style="list-style-type: none"> • Safety compliance: <ul style="list-style-type: none"> ○ CE marking ○ UL 60950 ○ CAN/CSA-C22.2 No. 60950 ○ EN 60950 ○ IEC 60950 ○ TS 001 ○ AS/NZS 3260 ○ IEC60825 ○ EN60825 ○ 21 CFR 1040 • EMC compliance: <ul style="list-style-type: none"> ○ FCC Part 15 (CFR 47) Class A ○ ICES-003 Class A ○ EN 55022 Class A ○ CISPR 22 Class A ○ AS/NZS 3548 Class A ○ VCCI Class A ○ KN22 Class A ○ CNS13438 Class A ○ CISPR24 ○ EN 55024 ○ EN 50082-1 ○ EN 61000-6-1 ○ EN 61000-3-2 ○ EN 61000-3-3 ○ EN300 386

Product specifications for the Cisco MDS 9700 Series Supervisor-1 Module

Table 12 lists the specifications for the Cisco MDS 9700 Series Supervisor-1 Module.

Table 12. Specifications for the Cisco MDS 9700 Series Supervisor-1 Module (part 1 of 3)

Feature	Description
Product compatibility	Cisco MDS 9700 Series
Software compatibility	Cisco MDS NX-OS Software Release 6.2.3 or later. NX-OS 6.2.5 is recommended.
Interfaces	<ul style="list-style-type: none"> • (1) RS-232 RJ-45 console port • (1) 10/100/1000 Ethernet management port • (2) USB 2.0 ports
Indicators	<ul style="list-style-type: none"> • Status LED • System LED • Power management LED • Active/standby LED
Backplane bandwidth	<ul style="list-style-type: none"> • Up to 24 Tbps of FC backplane bandwidth • Up to 384 2/4/8/16 Gbps Full Line Rate autosensing Fibre Channel and 10-Gbps fixed speed ports in a single chassis
Chassis slot configuration	Two Cisco MDS 9700 Series Supervisor-1 modules are required per system.

Table 12. Specifications for the Cisco MDS 9700 Series Supervisor-1 Module (part 2 of 3)

Feature	Description
Fabric services	<ul style="list-style-type: none"> ● Name server ● Registered State Change Notification (RSCN) ● Login services ● Fabric Configuration Server (FCS) ● Broadcast ● In-order delivery
Advanced functions	<ul style="list-style-type: none"> ● VSAN ● IVR ● PortChannel with multipath load balancing ● QoS-flow-based, zone-based ● FCC ● N_Port ID virtualization
Diagnostic and troubleshooting tools	<ul style="list-style-type: none"> ● POST diagnostic tests ● Online diagnostic tests ● Internal port loopbacks ● SPAN and RSPAN ● Fibre Channel Traceroute ● Fibre Channel Ping ● Fibre Channel Debug ● Cisco Fabric Analyzer ● Syslog ● Online system health ● Port-level statistics ● Real-Time Protocol Debug
Network security	<ul style="list-style-type: none"> ● VSANs ● ACLs ● Per-VSAN RBAC ● Fibre Channel zoning: <ul style="list-style-type: none"> ○ N_Port WWN ○ N_Port FC-ID ○ Fx_Port WWN ○ Fx_Port WWN and interface index ○ Fx_Port domain ID and interface index ○ Fx_Port domain ID and port number ○ LUN ○ Read-only ○ Broadcast ● FC-SP: <ul style="list-style-type: none"> ○ DH-CHAP switch-switch authentication ○ DH-CHAP host-switch authentication ● Port security and fabric binding ● Management access: <ul style="list-style-type: none"> ○ SSHv2 implementing AES ○ SNMPv3 implementing AES ○ SFTP
Serviceability	<ul style="list-style-type: none"> ● Configuration file management ● Nondisruptive software upgrades for Fibre Channel interfaces ● Call Home ● Power-management LEDs ● Port beaconing ● System LED ● SNMP traps for alerts ● Network boot

Table 12. Specifications for the Cisco MDS 9700 Series Supervisor-1 Module (part 3 of 3)

Feature	Description
Reliability and availability	<ul style="list-style-type: none"> ● Hot-swappable module ● Active-active redundancy ● Stateful Process Restart ● Stateful, nondisruptive supervisor failover ● Online, nondisruptive software upgrades ● Virtual Routing Redundancy Protocol (VRRP) for management ● Per-VSAN fabric services ● Power management ● Thermal management ● Fabric-based multipathing
Network management	<ul style="list-style-type: none"> ● Access methods through Cisco MDS 9700 Series Supervisor-1 Module: <ul style="list-style-type: none"> ○ Out-of-band 10/100/1000 Ethernet port ○ RS-232 serial console port ○ In-band IP over Fibre Channel ● Access protocols: <ul style="list-style-type: none"> ○ CLI-using console and Ethernet ports ○ SNMPv3-using Ethernet port and in-band IP over Fibre Channel access ● Distributed Device Alias service ● Network security: <ul style="list-style-type: none"> ○ Per-VSAN role-based access control by using RADIUS-based and TACACS+-based authentication, authorization, and accounting (AAA) functions ○ SFTP ○ SSHv2 implementing AES ○ SNMPv3 implementing AES ● Management applications: <ul style="list-style-type: none"> ○ Cisco MDS 9000 Family CLI ○ Cisco Data Center Network Manager
Programming interface	<ul style="list-style-type: none"> ● Scriptable CLI ● Data Center Network Manager web services API ● DCNM GUI
Physical dimensions	<ul style="list-style-type: none"> ● Dimensions (H x W x D): 5.18 x 19.05 x 55.37 cm (2.04 x 7.5 x 21.8 in.) ● Weight: 3.2 kg (7 lb)

Table 13 lists the feature codes for licensed software.

Table 13. Licensed software

Feature Code	Description
7610	MDS 9700 Enterprise Pkg
7611	DCNM SAN Advanced Edition MDS 9700
7612	MDS 9710 Mainframe Package

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IBM offers a vast portfolio of hardware, software, and services that can help organizations of all sizes address their IT infrastructure requirements in a comprehensive and integrated way. With IBM, organizations can create a more flexible, robust, and resilient infrastructure to support critical business operations.

Related information

For more information, see the following resources:

- Cisco MDS 9148S 16G Multilayer Fabric Switch for IBM System Storage, TIPS1255
<http://www.redbooks.ibm.com/abstracts/tips1255.html>
- Cisco MDS 9250i Multiservice Fabric Switch for IBM System Storage, TIPS1167
<http://www.redbooks.ibm.com/abstracts/tips1167.html>
- Cisco MDS 9396S 16G Multilayer Fabric Switch for IBM System Storage, REDP5274
<http://www.redbooks.ibm.com/abstracts/redp5274.html>
- Cisco MDS 9706 Multilayer Director for IBM System Storage, TIPS1256
<http://www.redbooks.ibm.com/abstracts/tips1256.html>
- Cisco MDS 9718 Multilayer Director for IBM Storage Networking, REDP5355
<http://www.redbooks.ibm.com/abstracts/redp5355.html>
- Cisco MDS 9710 Multilayer Director for IBM System Networking
<http://www.ibm.com/systems/networking/switches/san/ctype/9700/>
- Cisco MDS 9700 Series Multilayer Directors
<http://www.cisco.com/en/US/products/ps12970/index.html>
- Cisco MDS 9000 Family Pluggable Transceivers
<http://bit.ly/1dbyDXs>
- IBM Support Fix Central support site (select a product from drop-down menus)
<http://www.ibm.com/support/fixcentral/>
- IBM System Storage® Interoperation Center (SSIC)
<http://www.ibm.com/systems/support/storage/ssic/interoperability.wss>

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