Brochure

# The Cisco® MDS 9500 Series of Multilayer Directors

Addressing the stringent requirements of virtualized data center storage environments with high availability, scalability, intelligence, ease of management, and support for seamless deployment of converged Fibre Channel (FC) and Fibre Channel over Ethernet (FCoE) Fabrics.

**Figure 1.** Cisco MDS 9500 Multilayer Directors

## Cisco MDS 9500 Series Highlights

- **Multiprotocol Architecture:** The Cisco MDS 9500 Series of Multilayer Directors transparently integrate Fibre Channel, Fibre Channel over Ethernet (FCoE), IBM Fiber Connectivity (FICON), Internet Small Computer System Interface (iSCSI), and Fibre Channel over IP (FCIP) in one system.
  - **1/2/4/8-Gbps and 10-Gbps Fibre Channel:** The Cisco MDS 9513 Director natively integrates both 1/2/4/8-Gbps and 10-Gbps ports on the new 8-Gbps Advanced Fibre Channel switching modules. With 50% higher bandwidth than 8-Gbps Fibre Channel, 10-Gbps mode offers high performance connectivity suitable for Inter Switch Links (ISLs) and inter-data center connection over an optical infrastructure.
  - **10-Gbps Multihop FCoE:** The Cisco MDS 9500 Series of Multilayer Directors support multihop FCoE, extending convergence of SAN and LAN traffic from server access to network core while enabling connectivity to existing Fibre Channel SANs. The Cisco MDS 9500 Series of Directors supports extension of Fibre Channel SAN to devices that are connected using FCoE protocol over Ethernet, thereby extending the rich capabilities of intelligent services to unified fabric deployments.
  - **1/2/4/8-Gbps and 10-Gbps FICON:** The Cisco MDS 9500 Multilayer Directors support advanced FICON services including cascaded FICON fabrics, VSAN-enabled intermix of mainframe and open systems environments, and N_Port ID virtualization (NPIV) for mainframe Linux partitions. Cisco Control Unit Port (CUP) support enables in-band management of Cisco MDS 9000 Family switches from the mainframe management console.

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- **Industry-leading scalability:** The Cisco MDS 9500 Directors combine non-disruptive software upgrades, stateful process restart and failover, and full redundancy of all major components for best-in-class availability. With 8.4 terabits per second (Tbps) of system bandwidth and up to 528 1/2/4/8-Gbps autosensing Fibre Channel ports in a single chassis or up to 1584 Fibre Channel ports in a single rack, the Cisco MDS Directors lead the industry in scalability and are designed to meet the requirements of the largest data center storage environments. Furthermore, Cisco MDS Directors support all generations of Cisco MDS 9000 Family switching modules, providing outstanding investment protection.
- **Intelligent network services:** Integrated hardware-based VSANs and Inter-VSAN Routing (IVR), access control lists (ACLs) for hardware-based intelligent frame processing, and fabric-wide quality of service (QoS) enable migration from SAN islands to enterprise-wide storage networks. Furthermore, Cisco Arbitrated Local Switching feature provides high-performance, predictable, fair switching between all hosts attached to the same 8-Gbps Advanced Fibre Channel switching module and their associated storage devices.
- **Platform for intelligent storage applications:** The Cisco MDS 9500 Directors serve as a platform for intelligent services such as acceleration of storage applications for data replication and backup, storage media encryption for tapes and disks, data migration, and third-party applications such as continuous data protection and remote replication.
  - **IO Accelerator (IOA):** Cisco IOA is a transport- and speed-agnostic traffic acceleration service capable of mitigating the effects of distance (and hence latency) on application throughput, thereby bringing flexibility to the choice of the data center location.
  - **Cisco Storage Media Encryption (SME):** Cisco SME services offer solutions that enable companies to address Payment Card Industry (PCI) Data Security Standards (DSS) 2.0 compliance or other legislative regulations such as the Health Insurance Portability and Accountability Act (HIPAA), which require companies to store and protect data at rest for a specified number of years while publicly disclosing security breaches. Cisco SME enables data on disk arrays, tapes, and virtual tape libraries (VTLs) to be compressed, encrypted, and authenticated for centralized security management and data management and recovery.
  - **Cisco Data Mobility Manager (DMM):** Cisco DMM is a fabric-based data migration solution that does not require rewiring and that transfers block data non-disruptively across heterogeneous storage volumes and across distances, regardless of whether the host is online or offline.
- **Virtual Machine Transparency:** The Cisco MDS 9500 Series of Multilayer Directors provides deterministic hardware performance and a comprehensive feature set that allows virtual machines to have the same SAN attributes as a physical server. 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 available on a per-virtual machine basis to enable rapid troubleshooting in mission-critical virtualized environments.

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- **Comprehensive security:** In addition to support for services such as VSANs, hardware-enforced zoning, ACLs, per-VSAN role-based access control (RBAC), Cisco SME for tapes and disks, and Cisco TrustSec® Fibre Channel link encryption, the Cisco MDS 9000 Family supports a comprehensive security framework consisting of RADIUS and TACACS+, Fibre Channel Security Protocol (FC-SP), Secure File Transfer Protocol (SFTP), Secure Shell (SSH) Protocol, and Simple Network Management Protocol Version 3 (SNMPv3) implementing Advanced Encryption Standard (AES). Cisco TrustSec Fibre Channel link encryption delivers transparent, hardware-based 8-Gbps line-rate encryption of Fibre Channel data on both generations of 8-Gbps Fibre Channel switching modules in addition to 10-Gbps line-rate encryption on 8-Gbps Advanced Fibre Channel Switching modules.
- **Unified SAN management:** The Cisco MDS 9000 Family includes built-in storage network management with all features available through a command-line interface (CLI) or Cisco Data Center Network Manager (DCNM, formerly called Cisco Fabric Manager), a centralized management tool that simplifies management of unified fabrics. Cisco DCNM supports integration with third-party storage management applications to allow seamless interaction with existing management tools. Cisco DCNM supports federation of up to 10 Cisco DCNM servers to manage up to 150,000 devices using a single management pane.
- **Sophisticated diagnostics:** The Cisco MDS 9500 Series of Multilayer Directors provides intelligent diagnostics, protocol decoding, and network analysis tools as well as integrated Call Home capability for added reliability, faster problem resolution, and reduced service costs.

## Cisco MDS 9500 Series - Defining the Multilayer Director With Maximum Investment Protection

Cisco® MDS 9500 Series of Multilayer Directors provide director-class Storage Area Networking (SAN) switches designed for deployment in large scalable virtualized data centers and clouds. Layering a comprehensive set of intelligent features onto a high-performance, protocol-independent switch fabric, the Cisco MDS 9500 Directors address the stringent requirements of large virtualized data center storage environments: uncompromising high availability, security, scalability, ease of management, and transparent integration of new technologies for extremely flexible data center SAN solutions. Sharing the same operating system and management interface with other Cisco data center switches, the Cisco MDS 9500 Directors enable seamless deployment of unified fabrics with high-performance Fibre Channel and Fibre Channel over Ethernet (FCoE) connectivity to achieve low total cost of ownership (TCO). Compatible with all generations of Cisco MDS 9000 Family switching modules, the Cisco MDS 9500 Directors continue to provide outstanding investment protection.

## Scalable Convergence With Maximum Investment Protection

The Cisco MDS 9500 Director Series shares NX-OS Operating System and Data Center Network Manager (DCNM) management application across all MDS 9000 Family switching modules and Fabric Switches as well as Cisco Nexus 5000 and Nexus 7000 series switches to ensure management and feature consistency across the entire portfolio of Cisco data center switching products. The Cisco MDS 9500 Multilayer Directors support multihop FCoE, thereby extending scalable convergence of SAN and LAN traffic from server access to network core while enabling connectivity to existing Fibre Channel SANs to protect customer investment.

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## Cisco MDS 9500 Series System Summary

Table 1 compares hardware features within the Cisco MDS 9500 Series.

**Table 1.** Cisco MDS 9500 Series Hardware Feature Comparison

| Feature | Cisco MDS 9506 | Cisco MDS 9509 | Cisco MDS 9513 |
|---|---|---|---|
| **Available Slots** | 6 | 9 | 13 |
| **Redundant Supervisor** | Yes | Yes | Yes |
| **Maximum 10-Gbps FCoE Ports per Chassis** | 32 | 56 | 88 |
| **Maximum 1/2/4/8-Gbps Fibre Channel Ports per Chassis** | 192 | 336 | 528 |
| **Maximum 10-Gbps Fibre Channel Ports per Chassis** | 16 | 28 | 264 |
| **Maximum FCIP Ports per Chassis** | 64 | 112 | 176 |
| **Rack Units** | 7 | 14 | 14 |
| **Chassis per Rack** | 6 | 3 | 3 |
| **Fibre Channel Ports per Rack** | 1152 | 1008 | 1584 |

## 8-Gbps Advanced Fibre Channel Switching Modules

8-Gbps Advanced Fibre Channel Switching Modules, deliver high performance and innovative features to enable convergence, scalability, and intelligence in large, virtualized data centers.

Some of the key features of the 8-Gbps Advanced Fibre Channel Switching are:

- Up to 528 line-rate 8-Gbps Fibre Channel ports per chassis
- Cisco FlexSpeed: Flexible 1/2/4/8-Gbps and 10-Gbps Fibre Channel speeds supported on the same module
- Arbitrated Local Switching to support local switching across all ports of the module without any performance impact to traffic destined to/from the backplane
- Support for intelligent fabric services such as integrated VSANs, Inter-VSAN Routing (IVR), and PortChannels

The 8-Gbps Advanced Fibre Channel Switching modules are available in two configurations as shown in Figure 2:

- The 32-port 8-Gbps Advanced FC Switching Module offers up to 32-ports of line-rate 8G across the chassis backplane
- The 48-port 8-Gbps Advanced FC Switching Module offers up to 48-port oversubscribed at 1.5:1 for line rate 8G across the chassis backplane. All 48-ports can operate at 8G line-rate when locally switching.

**Figure 2.** Cisco MDS 9000 Family 32- and 48-Port 8-Gbps Advanced Fibre Channel Switching Modules

32-port 8-Gbps Advanced FC Module

48-port 8-Gbps Advanced FC Module

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## 10-Gbps 8-Port Fibre Channel Over Ethernet (FCoE) Module

Cisco MDS 9500 Series of Multilayer Directors support 10-Gbps 8-port Fibre Channel over Ethernet (FCoE) switching module with full line-rate FCoE connectivity to extend the benefits of FCoE beyond the access layer into the core of the data center network. Cisco MDS 9000 10-Gbps FCoE module (Figure 3) provides the industry's first multihop-capable FCoE module.

FCoE allows an evolutionary approach to I/O consolidation by preserving all Fibre Channel constructs, maintaining the latency, security, and traffic management attributes of Fibre Channel while preserving investments in Fibre Channel tools, training, and SANs. FCoE enables the preservation of Fibre Channel as the storage protocol in the data center while giving customers a viable solution for I/O consolidation.

Not only does the Cisco MDS 9000 10-Gbps 8-Port FCoE Module take advantage of migration of FCoE into the core layer, but it also extends enterprise-class Fibre Channel services to Cisco Nexus 7000 and 5000 Series Switches and FCoE initiators. This capability:

- Allows FCoE initiators to access remote Fibre Channel resources connected through Fibre Channel over IP (FCIP) for enterprise backup solutions
- Supports virtual SANs (VSANs) for resource separation and consolidation
- Supports inter-VSAN routing (IVR) to use resources that may be segmented

**Figure 3.** Cisco MDS 9000 Family 10-Gbps 8-Port FCoE Module

## 8-Gbps Fibre Channel Switching Modules

Cisco® MDS 9000 Family 8-Gbps Fibre Channel Switching Modules (Figure 4) deliver the intelligence and scalability required to support demanding storage applications, providing the foundation for large scale Storage Area Network (SAN) consolidation with low capital and operational costs.

Cisco MDS 9000 Family 8-Gbps Fibre Channel switching modules are available in three configurations:

- **The 24-Port 8-Gbps Fibre Channel Switching Module** delivers high performance for connecting storage subsystems and for Inter Switch Link (ISL) connectivity.
- **The 48-Port 8-Gbps Fibre Channel Switching Module** provides optimized performance and port density for connection of high-performance and virtualized servers.
- **The 4/44-Port 8-Gbps Host-Optimized Fibre Channel Switching Module** offers a very cost-effective solution for consolidating standard servers into the smallest number of SAN switches, in many cases eliminating the need for core-edge topologies.

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**Figure 4.** Cisco MDS 9000 Family 8-Gbps Fibre Channel Switching Modules


## 16-Port Storage Services Node

The Cisco® MDS 9000 16-Port Storage Services Node (Figure 5) provides a high-performance, flexible, unified platform for deploying enterprise-class disaster recovery, business continuance, and intelligent fabric applications. The 16-Port Storage Services Node offers Fibre Channel over IP (FCIP) for remote SAN Extension, Cisco IO Accelerator (IOA) to optimize the utilization of Metropolitan and Wide Area Network (MAN/WAN) resources for backup and replication using hardware-based compression, FC write acceleration, and FC tape read and write acceleration, and Cisco Storage Media Encryption (SME) to secure mission-critical data stored on heterogeneous disk, tape, and VTL drives. The Cisco MDS 9000 16-Port Storage Services Node hosts four independent service engines, which can each be individually and incrementally enabled to scale as business requirements change, or be configured to consolidate up to four fabric application instances to dramatically decrease hardware footprint and free valuable slots in the MDS 9500 Director chassis.

**Figure 5.** Cisco MDS 9000 16-Port Storage Services Node

## 18/4-Port Multiservice Module

The Cisco MDS 9000 18/4-Port Multiservice Module (Figure 6) offers 18 1-, 2-, and 4-Gbps Fibre Channel ports and four 1-Gigabit Ethernet IP storage services ports. It provides multiprotocol capabilities, integrating, in a single-form-factor, Fibre Channel, Fibre Channel over IP (FCIP), Cisco Storage Media Encryption (SME), Cisco MDS 9000 I/O Accelerator (IOA), Cisco Storage Services Enabler (SSE), Small Computer System Interface over IP (iSCSI), IBM Fibre Connection (FICON), FICON Control Unit Port (CUP) management, Cisco MDS 9000 Extended Remote Copy (XRC) Acceleration, and switch cascading. The Cisco® MDS 9000 18/4-Port Multiservice Module (MSM) is optimized for deployment of high-performance SAN extension solutions, distributed intelligent fabric services, and cost-effective IP storage and mainframe connectivity in enterprise storage networks.

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**Figure 6.** Cisco MDS 9000 18/4-Port Multiservice Module

## 10-Gbps Fibre Channel Switching Module

Cisco MDS 9000 Series supports 10-Gbps Fibre Channel switching with the Cisco MDS 9000 4-Port 10-Gbps Fibre Channel switching module. This module supports hot-swappable X2 optical SC interfaces. Modules can be configured with either short-wavelength or long-wavelength X2 transceivers for connectivity up to 300 meters and 10 kilometers, respectively. Figure 5 shows the Cisco MDS 9000 Family 4-Port 10-Gbps Fibre Channel switching module.

**Figure 7.** Cisco MDS 9000 Family 4-Port 10-Gbps Fibre Channel Switching Module

## Integrated Supervisor-2A Module

The Cisco MDS 9500 Series Supervisor-2A Module incorporates an integrated crossbar switching fabric. Designed to integrate multiprotocol switching and routing, intelligent SAN services, and storage applications onto highly scalable SAN switching platforms, the Cisco MDS 9500 Series Supervisor-2A Module enables intelligent, resilient, scalable, and secure high-performance multilayer SAN switching solutions. The Cisco MDS 9500 Series directors include two supervisor modules - a primary module and a redundant module. The modules occupy two slots in the Cisco MDS 9500 Series chassis, with the remaining slots available for switching modules. The active/standby configuration of the supervisor modules allows support of nondisruptive software upgrades. The supervisor module also supports stateful process restarts, allowing recovery from most process errors without a reset of the supervisor module and with no disruption to traffic. Figure 8 shows the Cisco MDS 9500 Series Supervisor-2A Module.

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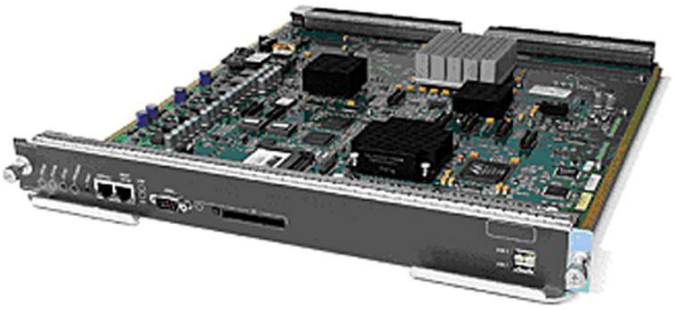
**Figure 8.** Cisco MDS 9500 Series Supervisor-2A Module



## Cisco MDS 9500 Series Advanced Features

### Convergence with Multihop FCoE

FCoE allows an evolutionary approach to network and I/O convergence by preserving all Fibre Channel constructs, maintaining the latency, security, and traffic management attributes of Fibre Channel and preserving investments in Fibre Channel tools, training, and SANs. With multihop FCoE connectivity, Cisco MDS 9500 Series of Multilayer Directors extends advanced fabric services to unified fabric deployments attached to Cisco Nexus® Family data center switches. Sharing the same operating system and management plane as the Cisco Nexus switches, the Cisco MDS 9500 Series of Directors provides seamless coexistence in a unified fabric with any-to-any connectivity for Fibre Channel, FCoE, iSCSI, and network-attached (NAS) storage.

### 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, Cisco MDS 9500 Series of Multilayer Directors offers industry-leading port densities of up to 528 8-Gbps or 264 10-Gbps Fibre Channel ports per chassis, multihop FCoE, high per-slot performance, intelligent fabric services, VSANs for consolidating individual physical SAN islands while maintaining logical delineations, and IVR for sharing resources across VSANs. These capabilities 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 operational expenses. For unified fabric deployments that have converged LAN and SAN using lossless Ethernet, the Cisco MDS 9500 Series of Multilayer Directors provides multihop FCoE capability to protect your investment in existing storage infrastructure with any-to-any connectivity across multiple protocols.

### Enterprise Class Availability

The Cisco MDS 9500 Series of Multilayer Directors was designed from the beginning for high availability. Beyond meeting the basic requirements of non-disruptive software upgrades and redundancy of all critical hardware components, the Cisco MDS 9500 software architecture offers an outstanding level of availability. The Cisco MDS 9500 Series Supervisor Modules automatically restart failed processes, making the Cisco MDS 9500 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 to traffic.

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High availability is implemented at the fabric level using robust and high-performance Inter-Switch Links (ISLs). PortChannel capability 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, helping ensure that the bundle can remain active in the event of a port, application-specific integrated circuit (ASIC), or module failure. The Cisco MDS 9500 takes high availability to a new level, helping ensure that solutions exceed the 99.999 percent uptime requirements of today's most demanding environments.

### Integrated Mainframe Support

The Cisco MDS 9500 Series of Multilayer Directors is mainframe-ready, with full support for IBM System z FICON and Linux environments. Qualified by IBM for attachment to all FICON-enabled devices in an IBM System z operating environment, the Cisco MDS 9500 Series supports transport of the FICON protocol in both cascaded and non-cascaded fabrics, as well as an intermix of FICON and open systems Fibre Channel Protocol traffic on the same switch. VSANs simplify an intermix of SAN resources between z/OS, mainframe Linux, and open systems environments, allowing for increased SAN utilization and simplified SAN management. VSAN-based intermix mode eliminates the uncertainty and instability often associated with zoning-based intermix techniques. VSANs also eliminate the possibility of a mis-configuration or component failure in one VSAN affecting operation in other VSANs. VSAN-based management access control simplifies partitioning of SAN management responsibilities between mainframe and open systems environments, enhancing security. FICON VSANs can be managed using the integrated Cisco Data Center Network Manager; the Cisco CLI; or IBM CUP-enabled management tools, including SA/390, Resource Measurement Facility (RMF), or Dynamic Channel Path Management (DCM). Extended Remote Copy (XRC) acceleration improves performance and bandwidth utilization over WAN links for IBM z/OS Global Mirror dynamic updates.

### Advanced Traffic Management

Advanced traffic management capabilities integrated into the Cisco MDS 9500 Series of Multilayer Directors 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.
- **Up to 4095 buffer-to-buffer credits:** Can be assigned to an individual port for optimal bandwidth utilization across distance.
- **PortChannels:** Allow users to aggregate up to 16 physical 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 across up to 16 FC or FCoE equal cost paths and, in the event of a switch failure, dynamically reroute traffic.
- **Quality of Service:** Can be used to manage bandwidth and control latency to prioritize critical traffic.
- **Port Bandwidth Reservation:** Allows users to define dedicated bandwidth on a per port basis.

### Ease of Management

To meet the needs of all users, the Cisco MDS 9500 Series of Multilayer Directors provides three principal modes of management: the Cisco MDS 9000 Family CLI, Cisco Data Center Network Manager (DCNM), and integration with third-party storage management tools.

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The Cisco MDS 9500 Directors present the user with a consistent, logical CLI. Adhering to the syntax of the widely known Cisco IOS® Software CLI, the Cisco MDS 9000 Family CLI is easy to learn and delivers broad management capabilities. The Cisco MDS 9000 Family CLI is an extremely efficient and direct interface designed to provide optimal capabilities to administrators in enterprise environments.

Cisco DCNM (formerly Cisco Fabric Manager) is an easy-to-use application that simplifies management across multiple switches and converged fabrics. Focused on supporting efficient operations and management of virtual machine-aware fabrics, Cisco DCNM provides a robust framework and rich feature set that meet the routing, switching, and storage administration needs of present and future virtualized data centers. Cisco DCNM streamlines provisioning of the unified fabric and proactively monitors the LAN and SAN components. Cisco DCNM can be licensed for managing a combination of SAN and LAN environments.

Cisco DCNM can be used independently or in conjunction with third-party management applications. Cisco provides an extensive API for integration with third-party and user-developed management tools.

### Comprehensive Solution for Robust Security

Addressing the need for fool-proof security in storage networks, the Cisco MDS 9500 Series of Multilayer Directors offers an extensive security framework to protect the highly sensitive data crossing today's enterprise networks. The Cisco MDS 9500 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 higher security and greater stability by providing complete isolation among 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 Diffie-Hellman Challenge Handshake Authentication Protocol (DH-CHAP) authentication supporting RADIUS or TACACS+, to help ensure that only authorized devices access protected storage networks. Cisco TrustSec Fibre Channel link encryption, available on the Cisco MDS 9000 Family 8-Gbps modules, allows you to transparently encrypt ISLs at line-rate 8-Gbps or the 10-Gbps Fibre Channel rate, providing an additional layer of protection for traffic within and between data centers.

## 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 Cisco MDS 9500 Series of Multilayer Directors integrates advanced analysis and debug tools. Power-on self test (POST) and online diagnostics provide proactive health monitoring. The Cisco MDS 9500 Series provides the integrated functionality required to implement diagnostic capabilities such as Fibre Channel Traceroute for detailing the exact path and timing of flows and Switched Port Analyzer (SPAN) and Remote Switched Port Analyzer (RSPAN) to intelligently capture network traffic. 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 enable sophisticated performance analysis and service-level agreement (SLA) accounting. With the Cisco MDS 9500 Series of Directors, Cisco delivers a comprehensive toolset for troubleshooting and analysis of storage networks.

## Services for Cisco Storage Networking

Delivered through an ecosystem of best-of-breed storage service partners or directly by Cisco, storage networking services provide high-touch services to enable you to successfully assess, plan, design, implement, and operate storage networks while helping to ensure seamless deployment of unified fabrics with high performance FC and FCoE connectivity, uncompromising high availability, scalability, intelligent fabric applications, and ease of management.

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