

# FICON Migration: Increase Ease, Cost-Effectiveness, and Benefits

## Abstract

Enterprise IT groups have compelling reasons to migrate to the 4-Gbps IBM Fiber Connection (FICON) mainframe I/O protocol, whether they are currently using the Enterprise Systems Connection (ESCON) protocol or 1/2-Gbps FICON. In either case, performance increases because 4-Gbps FICON supports faster control units such as direct access storage devices (DASDs) and virtual tape libraries (VTLs) and takes advantage of the 4-Gbps channel speeds of IBM System z.

Organizations that currently use ESCON gain additional benefits from migrating to FICON, such as:

- Extended distances: FICON supports connections to more distant data centers for business continuity and disaster recovery without the use of channel extenders
- Increased addressing capabilities
- Consolidation of ESCON channels and cards, freeing up mainframe slots

The Cisco® MDS 9500 Series Multilayer Director switch has unique capabilities that increase the ease of migration, reduce ongoing operational costs, and provide enhanced performance and availability. This white paper, intended for enterprise IT groups, discusses the benefits of migrating to 4-Gbps FICON; the advantages of the Cisco MDS 9500 Series Multilayer Director switch; and how this switch enables migration from 1/2-Gbps FICON to 4 Gbps without business disruption. The first part of the white paper concerns migration from ESCON to 4-Gbps FICON, and the second part focuses on migration from 1/2-Gbps FICON to 4-Gbps FICON.

## Migrating from ESCON to FICON

### Migration Benefits

Organizations gain the following benefits by migrating from ESCON to FICON for connecting mainframes to control units:

- Increased performance: A 400-MB FICON channel provides approximately 20 times greater performance than a 17-MB ESCON channel. This means that a backup that takes 1 hour over a single ESCON link takes just 5 minutes or less with a single FICON link, decreasing network utilization and improving disaster recovery capabilities.
- Lower-cost connectivity to remote data centers: Many disaster recovery sites are more than 100 kilometers (km) from the main data center, but ESCON only supports distances up to 20 km. Therefore, organizations that use ESCON need to deploy ESCON channel-extension solutions, increasing hardware costs and WAN bandwidth utilization. In contrast, FICON inherently supports distances of 100 to 300 km, reducing or even eliminating the need for costly channel-extension solutions.

- Increased subchannel addressability: FICON supports 1024 channel path identifiers (CHPIDs) compared to 256 in ESCON; 65,000 control units compared to 1000 in ESCON; and 60 logical partitions compared to 15 in ESCON.<sup>1</sup>
- Replacement of obsolete technology: Two-port FICON and FICON Express cards are no longer sold and soon will no longer be supported.

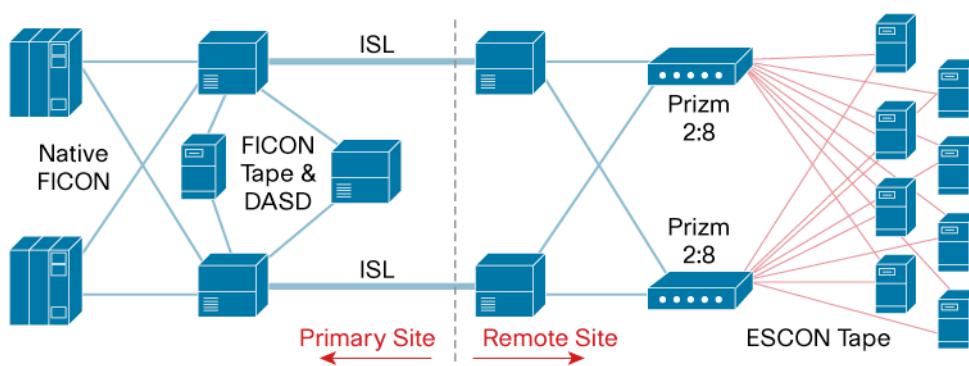
### Factors Affecting the Ease and Cost of Migration from ESCON to FICON

The director or switch used for the FICON solution can affect the ease and cost of migration, as well as ongoing operational costs. A major factor affecting costs is whether the director or switch can support existing ESCON control units. Many organizations have a significant investment in ESCON tape drives, check sorters, printers, front-end processors for business continuity/disaster recovery access, or optical storage for long-term storage. Even after migrating to FICON, these organizations often need to maintain costly ESCON directors, channel cards, and channel extenders just to support the remaining ESCON devices. This is becoming a major issue because of the approaching end of support for ESCON directors and ESCON bridge cards. Organizations can reduce hardware and support costs if they deploy a director switch with compatibility and connectivity support for ESCON control units, which eliminates the need for outdated hardware, such as ESCON directors or channel extension products.

### Cisco Solution for Migration from ESCON to FICON

Organizations can ease this situation and provide an easy migration from ESCON to FICON by deploying the Cisco MDS 9500 Series Multilayer Director with the Prizm FICON-to-ESCON converter from Optica, a Cisco partner (Figure 1). The solution allows FICON channel traffic to communicate with existing ESCON control units through FICON directors, over FICON inter-switch links (ISLs), and also Fibre Channel over IP (FCIP) links. This reduces or eliminates the need for ESCON channels and ESCON directors to support existing ESCON control units. A Cisco MDS 9500 Series Multilayer Director can rapidly pay for itself, in many cases, by eliminating the costs of existing ESCON directors and channel extension equipment, including the increasing maintenance costs. Bandwidth expenses, dedicated WAN and telecommunications links costs, as well as environmental costs associated with the data center (power, cooling, space, etc) are also reduced.

**Figure 1.** FICON-to-ESCON Conversion



Following are the advantages of the Cisco MDS 9500 Series Multilayer Director for migration from ESCON to FICON. These same advantages also apply to organizations migrating from 1/2-Gbps FICON to 4-Gbps FICON.

<sup>1</sup> For 60 logical partitions, four Logical Channel Subsystems (LCSS) are required.

### Increased Flexibility and Security

The Cisco MDS 9500 Series Multilayer Director creates FICON virtual storage area networks (VSANs), which are analogous to mainframe logical partitions (LPARs). VSANs maintain complete separation between different traffic types, including production, development and test, open systems and mainframe, tape and disk, and local and disaster recovery.

Cisco VSAN technology provides significant advantages compared to other approaches to FICON fabric management. Unlike administrative domains, which simply mask membership lists, zoning privileges, and configuration settings from manipulation by unauthorized users, Cisco MDS 9500 Series Multilayer Directors create completely separate virtual fabrics, with separate fabric services complete with separate control unit port (CUP) interfaces, within the same physical director. This provides much better security, resilience, and isolation for troubleshooting and other purposes. Unlike logical SANs (LSANs), Cisco VSANs do not require Fibre Channel routing appliances or blades, which increase hardware costs and insert additional points of failure. In addition, Cisco VSANs are fully supported by IBM mainframes, whereas LSANs use unsupported technologies, which utilize methodologies similar to Fibre Channel Network Address Translation (FC NAT) and Domain ID spoofing.

The Cisco MDS 9500 Series Multilayer Director complies with Federal Information Processing Standards (FIPS) for information security.

### Qualified to Work with IBM Mainframes

Cisco MDS 9000 Series products have been tested in the IBM FICON qualification lab in New York. The IBM internal test suite tool tests for performance in basic conditions, and also performs regression testing for every known failure. Cisco also collaborates with Emulex in numerous programs, and Emulex provides the underlying technology for the IBM FICON Channel cards.

### High Buffer-to-Buffer Credit Level, for Long-Distance Data Transfers

The Cisco MDS 9500 Series Multilayer Director provides up to 4095 Buffer-to-Buffer credits for each port, the highest credit level available in the industry. This enables the switch to support data transfers of up to 300 km over dark fiber at rates of 10 Gbps. Integrated coarse wavelength-division multiplexing (CWDM) Small Form-Factor Pluggable (SFP) optical transceivers can deliver 2/4-Gbps FICON up to 100 km with eight wavelengths. Dense wavelength-division multiplexing (DWDM) SFP optics can deliver 2-Gbps FICON up to 300 km, with 32 wavelengths, over dark fiber.

### Low Failure Rate for SFP Optics, and Low Impact of Failure

Line cards for the Cisco MDS 9500 Series Multilayer Director are available with 48, 24, or 12 ports, each supporting rates of 4 Gbps, 2 Gbps, or 1 Gbps in varying subscription rates. Organizations have the option to deploy four full-rate 12-port cards instead of one 48-port card, for example, so that if one card requires service, the other 36 ports can continue operating without interruption. Cisco manufactures its own SFP optics, which are subject to strict quality standards, to help ensure a low failure rate and avoid potential incompatibility and quality problems that arise when vendors use SFP optics from a variety of manufacturers.

### Single Management Interface

All components in the Cisco MDS 9000 Family, including integrated line modules, can be managed using a single interface, the Cisco Fabric Manager and Cisco Device Manager.

## Migrating from 1/2-Gbps FICON to 4-Gbps FICON

### Migration Benefits

Advantages of upgrading from 1/2-Gbps FICON to 4-Gbps FICON include:

- Ability to take full advantage of IBM System z 4-Gbps channel speeds and faster control units: IT groups that use 4-Gbps FICON can deploy newer 4-Gbps DASDs and VTLs. They can also use these control units' higher-capacity media and improved features.
- Consolidation of ESCON channels and cards: Four-port 4-Gbps FICON Express4 cards provide 2000-MB theoretical bandwidth, compared to 320-MB theoretical bandwidth for 16-port ESCON cards. Therefore, by replacing the ESCON cards with new 4-Gbps FICON Express4 cards, IT groups increase theoretical bandwidth at the same time they free up slots in the mainframe chassis for other new Crypto Express2 cards and 10-Gbps Ethernet OSA Express2 cards.

### Factors Affecting the Ease and Cost of Migration from 1/2-Gbps FICON to 4-Gbps FICON

Migration costs depend on how much switch hardware must be replaced to upgrade to 4-Gbps FICON or future 8-Gbps FICON. Replacing line cards and control processors costs much less than replacing the entire chassis.

In addition, migration is simpler with a director switch that enables the organization to adopt FICON without disrupting the business. Ideally, the IT group should be able to maintain its mainframe service-level agreements (SLAs) during the transition when the FICON environment is architected and deployed properly.

### Cisco Solution for Migration from 1/2-Gbps FICON to 4-Gbps FICON

The Cisco MDS 9500 Series Multilayer Director eases the migration to 4-Gbps FICON, provides leading performance and availability, and reduces costs. It provides all of the benefits described in the previous section of this white paper, on migration from ESCON to FICON, as well as the following additional advantages.

#### Integrated Tape Acceleration

The Cisco MDS 9500 Series Multilayer Director integrates FCIP technologies into the chassis, eliminating hardware and support costs for an external unit for FICON tape acceleration. The internal Cisco FICON Tape Acceleration feature increases the speed of write transfers. It is available on any of the following line modules: Cisco MDS 9000 4-Port and 8-Port IP Storage Services Modules; Cisco MDS 9000 14/2-Port Multiprotocol Services Module; or the new feature-rich Cisco MDS 9000 18/4-Port Multiservice Module.

#### Forward and Backward Compatibility

The operating system used in the Cisco MDS 9000 Family of directors is the same on all products, and is designed to support FICON data rates of 8 Gbps and faster as the technology becomes available.

#### ESCON-Like Functionality, for Reduced Training Requirements

Cisco has licensed the Control Unit Port (CUP) specification from IBM. Therefore, like ESCON directors, the Cisco MDS 9000 Series directors and switches provide up to eight FICON CUP interfaces (one per each VSAN) which the IT group can use for management support, performance monitoring, and error reporting. The FICON CUP interfaces are essentially identical to the ESCON CUP interface. They provide the typical management functions such as the Prohibit/Allow feature, which enables the IT group to block, prohibit, or swap ports. The FICON CUP also provides data to

operations such as the Remote Monitoring Facilities (RMF) feature, which provides performance reporting that is useful for I/O tuning.

The management interface for the Cisco MDS 9500 Series Multilayer Director management interface can be easily configured for FICON management staff, representing port addresses in hexadecimal format for easy correlation with the IOCDs addressing schema. Similarly, ports can be labeled on the user interface with either the logical hexadecimal address or the decimal value to help facilities personnel identify the location of referenced ports.

### High Availability

The Cisco MDS 9500 Series Multilayer Director provides industry-leading performance and availability because of its serial crossbar design (Figure 2). Unlike director switches designed around application-specific integrated circuits (ASICs) that share memory in a multi-stage methodology, the Cisco director switch uses efficient and proven serial crossbar technology, which delivers consistent fabric latency, often less than the previous latency, and can continue performing at 100 percent of ordinary levels during upgrades or when a component fails.

**Figure 2.** Serial Crossbar Technology Eliminates the Inherent Bottleneck of Shared Memory

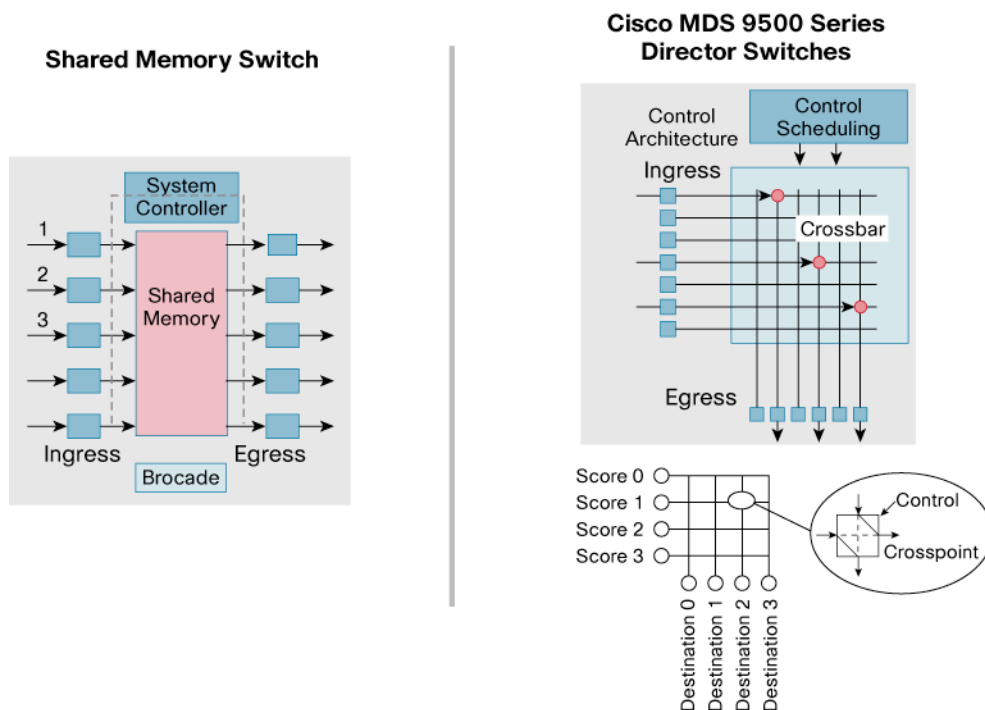


Table 1 summarizes the advantages of serial crossbar technology compared to shared-memory designs.

**Table 1.** Advantages of Cisco Monolithic Serial Crossbar Technology for Performance and Availability

Switch Attribute	Cisco MDS 9500 Series Multilayer Director (Monolithic Serial Crossbar Design)	Other Director Switches (Shared-Memory Design)
<b>Fabric latency</b>	Deterministic	Variable and inconsistent
<b>Non-disruptive microcode upgrades</b>	Nondisruptive; performance remains at 100%	Up to 50% performance degradation
<b>High availability</b>	If a serial crossbar fails, the standby serial crossbar takes over immediately, with no loss of data or performance	Ordinarily, two ASICs share the load. When one fails, the other takes over its load, resulting in oversubscription that degrades performance by 50% and can result in lost data

Switch Attribute	Cisco MDS 9500 Series Multilayer Director (Monolithic Serial Crossbar Design)	Other Director Switches (Shared-Memory Design)
<b>Troubleshooting</b>	Simple because Cisco tracks CRC errors at each component handoff, providing deterministic fault isolation	More complex because CRC errors are not detected between each component handoff, thus complicating fault location and identification

## Migration Options for 1/2-Gbps FICON to 4-Gbps FICON

The Cisco MDS 9500 Series Multilayer Director enables gradual migration to 4-Gbps FICON without any changes to the mainframe. This avoids business disruption, a safe option compared to an all-at-once migration.

If the data center is already utilizing virtually all available power, space, and cooling, the IT group can deploy one or more Cisco MDS 9500 Series Multilayer Directors, connect them to existing devices and applications, and then disconnect the previously existing FICON director switch to free up power and rack space for another Cisco MDS 9500 Series Multilayer Director. The process is repeated until all devices and applications are connected through the Cisco director switches.

Typically, the IT group determines which devices and applications to connect to the new switch based on the CHPID, DASD port, or tape drive port, or when the devices are scheduled for CHPID assignment, DASD refresh, or CEC refresh. In other cases, the IT group might need to change the Input-Output Configuration Data Set (IOCDS) so that traffic exits through a different switch address and port combination.

Compared to other director switches, the Cisco MDS 9500 Series Director simplifies the migration process. Other director switches can require the IT group to define or redefine the principal switch, domain ID (switch address), fabric- and switch-binding security options, interoperability modes, port speeds, port types, and potentially the error detect and resource allocation timers. With Cisco director switches, in contrast, IT simply sets up a VSAN, and the basic corresponding settings, to represent each director that is removed. This is possible because the director switch can associate any FICON port number with any interface, reuse FICON port numbers in different VSANs, and assign each VSAN its own set of fabric services, including a separate CUP. The Cisco MDS 9500 Series Multilayer Director can also replicate the domain ID and fabric-binding characteristics of every director switch or cascaded pair that is replaced. For companies replacing McDATA FICON switches, Cisco VSAN technology can use persistent FCID to precisely match the existing McDATA FICON configuration, including a port offset starting at 0xDD0413, without requiring a change to the IOCDS. When the VSAN is fully configured and its configuration has been verified to match that of the outgoing director, the cables are moved and the CHPIDs and devices are brought back online.

If the data center has adequate power, space, and cooling, the organization can deploy a parallel infrastructure while the old one continues to operate. The advantage of this approach is that the organization can quickly revert to the original I/O infrastructure if issues arise during the transition.

Some organizations prefer to cut over to FICON all at once, during a planned outage window. Organizations that take this approach need to configure the Cisco MDS 9000 Series directors or switches' VSANs to precisely match the previous environment. With either methodology, IT organizations also need to review the following items to ensure that changes in the architecture correlated properly and did not require changes to the following, including:

- IOCDS
- Macros, including esoterics
- Switch address (domain ID)

- Cable repositioning and port numbering offsets
- Prohibit/allow matrices
- Zoning
- ISL policies
- Security features

## Conclusion

Whether an organization is considering an ESCON-to-FICON migration or an upgrade from 1/2-Gbps FICON, they have a strong business case to migrate to 4-Gbps FICON now. Cisco's FICON solutions are encompassing and efficient for IT organizations to design and deploy. The entire Cisco MDS 9000 Series of directors and switches increase the ease and lower the costs of migration, and provide industry-leading performance, availability, and resiliency.

## For More Information

To read more about the Cisco MDS 9500 Series Multilayer Director, visit:

<http://www.cisco.com/en/US/products/ps5990/index.html>

For assistance in planning or executing a migration from ESCON to FICON or from 1/2-Gbps FICON to 4-Gbps FICON, contact the Cisco Advanced Services group:

[http://www.cisco.com/en/US/products/svcs/ps2961/ps3010/serv\\_group\\_home.html](http://www.cisco.com/en/US/products/svcs/ps2961/ps3010/serv_group_home.html)



**Americas Headquarters**  
Cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, CA 95134-1706  
USA  
www.cisco.com  
Tel: 408 526-4000  
800 553-NETS (6387)  
Fax: 408 527-0883

**Asia Pacific Headquarters**  
Cisco Systems (USA) Pte. Ltd.  
168 Robinson Road  
#28-01 Capital Tower  
Singapore 068912  
www.cisco.com  
Tel: +65 6317 7777  
Fax: +65 6317 7799

**Europe Headquarters**  
Cisco Systems International BV  
Haarlerbergpark  
Haarlerbergweg 13-19  
1101 CH Amsterdam  
The Netherlands  
www-europe.cisco.com  
Tel: +31 0 800 020 0791  
Fax: +31 0 20 357 1100

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