



## Cisco MDS 9000 Family Investment Protection

**The first-generation Cisco® MDS 9000 Family multiprotocol intelligent SAN switches were released in December 2002. The initial product release consisted of a chassis, a supervisor module, and just two linecards—a 16-port 1/2-Gbps Fibre Channel linecard and a 32-port 1/2-Gbps linecard. In the subsequent three years, Cisco Systems® extended the capabilities of the Cisco MDS 9000 Family through the release of multiprotocol and intelligent Fibre Channel linecards, increasing the initial suite of two linecards up to a family of eight linecard modules and multiple chassis.**

The second-generation Cisco MDS 9000 Family linecards, supervisors, and chassis further strengthen Cisco's technology leadership in the SAN switching marketplace. Cisco has layered even more intelligence into the SAN switching fabric, more than doubling the port densities offered by most other SAN switches.

One unique feature of the Cisco MDS switch architecture is the investment protection Cisco offers. Cisco second-generation linecards and chassis offer both backward and forward compatibility. This means that all existing first-generation linecards can be used alongside second-generation linecards and second-generation linecards can be used in first-generation chassis, typically without any requirement for supervisor module upgrades. Cisco offers both investment protection and a nondisruptive upgrade path to higher port density SAN switching.

### AUDIENCE

This white paper serves as a guide to the investment protection offered between first-generation and second-generation Cisco MDS 9000 Family linecards, supervisor, and chassis. This paper provides information and guidance about what equipment can interoperate and provides details about any caveats associated with mixing and matching equipment across generations.

### EVOLUTION OF THE CISCO MDS 9000 FAMILY

In December 2002, Cisco released the high-performance Fiber Channel Cisco MDS 9509 Multilayer Director, with a maximum system density of 224 1/2-Gbps Fibre Channel ports. First-generation Cisco MDS 9000 Family linecards connected to dual crossbar switch fabrics in all Cisco MDS 9500 Series resulting in a total system switching capacity of 1.4 Tbps on the Cisco MDS 9509.

Three years on, Cisco has introduced second-generation linecards, crossbars (supervisors), and the Cisco MDS 9513 Multilayer Director. System density has grown to a maximum of 528 Fibre Channel ports operating at 1/2/4-Gbps or 44 10-Gbps Fibre Channel ports in the MDS 9513, delivering a total system switching capacity of 2.20 Tbps.

Supervisor-2 and second-generation higher-density linecards enable the existing 9-slot Cisco MDS 9509 to scale to a maximum system density of 336 1/2/4-Gbps Fibre Channel ports and enables the 6-slot Cisco MDS 9506 Multilayer Director to grow to a maximum of 192 1/2/4-Gbps Fibre Channel ports.

As well as increasing port speeds and density, Cisco also offers investment protection. All existing first-generation Cisco MDS linecards can operate alongside second-generation linecards, chassis, and supervisors. Conversely, second-generation Cisco MDS linecards can be used in conjunction with existing first-generation linecards, chassis, and supervisors.

## UPGRADE CONSIDERATIONS

The introduction of second-generation hardware represents an evolutionary step for Cisco MDS 9000 Family switches. Although second-generation linecard modules provide higher-speed interfaces in a higher-density package, the fundamental switch architecture and frame flow remain the same, allowing modules from either generation to be mixed and matched.

There are three factors to consider when mixing different generation modules or expanding the number of modules within an existing switch:

- Port indexes
- Cisco MDS 9000 SAN-OS Software release
- Available power

### Port Indexes

Internally, all Cisco MDS 9000 Family switches identify front-panel ports using port indexes. These are used internally within the switch to identify ingress and egress ports when switching frames. Because there are a large variety of linecard modules with different numbers and types of front-panel ports, the Cisco MDS architecture has always been flexible in supporting different numbers of port indexes associated with each linecard module. Generally speaking, there is a one-for-one association between port indexes and front-panel ports. That is, a 16-port linecard requires 16 port indexes, a 32-port linecard requires 32 port indexes, and so on. There are some exceptions: IP services modules (IPS-4, IPS-8) and multiprotocol service modules (MPS-14/2) require four port indexes per Gigabit Ethernet port in order to support three Fibre Channel over IP (FCIP) tunnels and Small Computer System Interface over IP (iSCSI) gateway functionality on each Gigabit Ethernet port, with virtual output queuing (VOQ) on a per-tunnel or per-gateway basis.

The total number of port indexes required by the system is an important factor in determining whether different generation linecard modules can be used in the same chassis together. Both Supervisor-1 and all first-generation linecard modules support a maximum of 256 port indexes. This means that a switch with either Supervisor-1 or any first-generation linecard module is limited to a maximum of 256 indexes. Dual supervisors use four indexes internally, reducing the number of port indexes available for linecards to a maximum of 252.

Supervisor-2 and second-generation linecard modules support up to 1024 port indexes per switch, allowing far higher system port densities.

Note, however, that a switch is still limited to 256 port indexes if a first-generation linecard module is inserted into the switch.

A switch will not power up a linecard module if it exceeds the maximum number of supported port indexes:

- A switch with Supervisor-2 modules and second-generation linecards will only power up newly inserted first-generation linecard modules if the total number of port indexes in the switch does not exceed 256
- A switch with Supervisor-1 modules or first-generation linecards will only power up newly inserted second-generation linecard modules if a sufficient number of port indexes in the range 0 through 255 is available

In the case of multiple modules being inserted simultaneously (for example, when turning on the power switch), port indexes are allocated in order from first slot to last slot.

To see how many port indexes are allocated, the command-line interface (CLI) command **show system internal index-allocation** can be used. Refer to Table 1 (in the next section) for a list of linecards and the number of port indexes required by each linecard.

### Cisco MDS 9000 SAN-OS Software Release

All second-generation linecards require Cisco MDS 9000 SAN-OS Software Release 3.0 or later. Adding a second-generation linecard into an existing chassis will require a nondisruptive code upgrade to Cisco MDS 9000 SAN-OS Software Release 3.0.

## Distribution of Power Within the Switch

Cisco MDS 9000 Family switches have always offered flexible input power to the switch: 110VAC and 220/240VAC, and -48 to 60V DC power on the Cisco MDS 9509, and both 2500W and 4000W power supplies on the 9-slot Cisco MDS 9509 chassis. These switches also offer flexibility in how power is distributed throughout the switch itself—power supplies can operate in either redundant mode or combined mode.

From an investment-protection standpoint, the wide range of power-supply options means that Cisco MDS 9000 Family switches offer the opportunity to support future modules. Actual current draw of modules in most deployed chassis is typically far below the 2500W or 4000W (Cisco MDS 9509) or 1900W (Cisco MDS 9506) available power from the power supplies. This has always opened possibilities for support of future linecards with as-yet-undetermined power requirements.

The amount of power available within a chassis for adding additional linecard modules is visible both on the command line (**show environment power**) and in Cisco Fabric Manager (Device Manager -> Physical -> Power Supplies).

Table 1, later in this document, shows the power requirements for each type of linecard and whether adding additional linecards will fit within the available switch internal power budget.

Note that as of SAN-OS 3.0, Cisco is reducing the power requirements of various first-generation linecards. This reduction is a cosmetic decrease; the power consumption numbers used internally for calculations on whether the system had sufficient power were very conservative, with true maximum power draw less than what the system specified.

## CISCO MDS 9216, MDS 9216A, AND MDS 9216I MULTILAYER FABRIC SWITCHES

Second-generation linecard modules are fully supported and can be inserted into the second slot of Cisco MDS 9216A and MDS 9216i multilayer fabric switches, providing up to 64 Fibre Channel ports in a single modular fabric switch. Like Cisco MDS 9500 Series multilayer directors, Cisco MDS 9216A and MDS 9216i multilayer fabric switches require Cisco MDS 9000 SAN-OS Software Release 3.0 or later to support second-generation linecard modules.

Second-generation linecard modules are not supported on the original Cisco MDS 9216 switch.

To confirm what model the switch is (Cisco MDS 9216, MDS 9216A, or MDS 9216i), refer to the model number on the front of the switch, use the **show srom backplane 1** CLI command, or check using Cisco Fabric Manager (Device Manager->Physical->Modules).

## SUMMARY OF LINECARDS

Table 1 provides a summary of all the linecard modules within the Cisco MDS 9000 Family, both first-generation and second-generation; port indexes required; and power requirements.

**Table 1.** Linecard Summary

Cisco Part Number	Linecard Description	Gen	Ports		Number of Port Indices required	Power Required		Targeted Function
			FC	GE		Prior to SAN-OS 3.0	SAN-OS 3.0 and later	
<b>DS-X9016</b>	16-port 1/2-Gbps Fibre Channel module	1st	16	–	16	220.08W	210.08W	High-performance host, ISL, storage
<b>DS-X9032</b>	32-port 1/2-Gbps Fibre Channel module		32	–	32	199.92W	190.83W	Optimized for host connectivity
<b>DS-X9032-SSM</b>	32-port 1/2-Gbps Fibre Channel storage services module		32	–	32	295.00W	281.59W	Host connectivity with storage services
<b>DS-X9302-14K9</b>	2-port 1-Gigabit Ethernet IPS, 14-port 1/2-Gbps Fibre Channel module		14	2	22	220.08W	210.08W	Very long-distance Fibre Channel SAN ISL extension, IP SAN extension, iSCSI
<b>DS-X9304-SMIP</b>	4-port IP storage services module		–	4	16	168.00W	160.36W	IP SAN extension, iSCSI
<b>DS-X9308-SMIP</b>	8-port IP storage services module		–	8	32	210.00W	200.45W	IP SAN extension, iSCSI
<b>DS-X9112</b>	12-port 1/2/4-Gbps Fibre Channel module	2nd	12	–	12	–	132.00W	High-performance 1/2/4-Gbps host/storage/ISL including very long-distance Fibre Channel SAN ISLs
<b>DS-X9124</b>	24-port 1/2/4-Gbps Fibre Channel module		24	–	24	–	147.00W	
<b>DS-X9148</b>	48-port 1/2/4-Gbps Fibre Channel module		48	–	48	–	185.00W	
<b>DS-X9704</b>	4-port 10-Gbps Fibre Channel module		4	–	4	–	172.00W	High-performance 10G ISL (up to 800 km)

## DEPLOYMENT EXAMPLE

Bob has a Cisco MDS 9509 equipped with two 16-port linecards, two 32-port linecards, two Supervisor-1 modules, and two 2500W power supplies. What future upgrade options exist? (See Figure 1 and Figure 2.)

Bob's current chassis configuration of 96 ports leaves him with three spare slots that can be used for any generation linecard modules:

- **Port indexes**—Because Bob already has first-generation linecard modules and Supervisor-1 modules, his Cisco MDS 9509 chassis will be limited to a maximum of 252 port indexes—96 port indexes are used by the existing linecards, leaving 156 port indexes remaining.
- **Available power**—In the current configuration, 899W power remains available for the three unused slots.

Assuming Bob wanted to expand his existing Cisco MDS 9509 to the maximum density possible while preserving his existing investment in linecards, he could add three 48-port linecard modules into the three spare slots. He could continue to use all the existing linecard modules he had already deployed.

This would result in his fully populated Cisco MDS 9509 topping out at 240 Fibre Channel ports, with 96 1/2-Gbps ports on first-generation modules he retained and 144 1/2-Gbps ports on second-generation modules.

**Figure 1.** Switch Configuration Prior to Upgrade

### Before – 96 ports

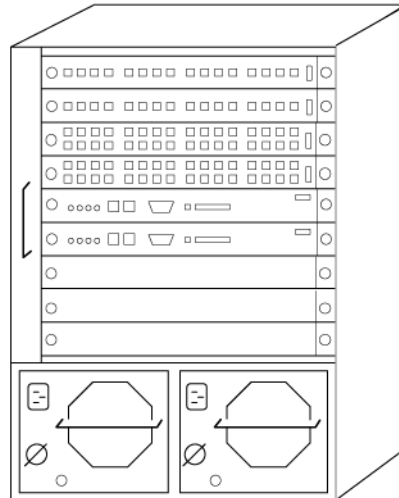
```

MDS# show environment power
-----
PS  Model                Power      Power      Status
   (Watts)      (Amp @42V)
-----
1   DS-CAC-2500W         2331.00   55.50     ok
2   DS-CAC-2500W         2331.00   55.50     ok

Mod Model                Power      Power
Requested Requested
(Watts)    (Amp @42V)
-----
1   DS-X9016              210.08    5.00
2   DS-X9016              210.08    5.00
3   DS-X9032              190.83    4.54
4   DS-X9032              190.83    4.54
5   DS-X9530-SF1-K9       210.08    5.00
6   DS-X9530-SF1-K9       210.08    5.00

Power Usage Summary:
-----
Power Supply redundancy mode:      redundant
Total Power Capacity              2331.00 W
Power reserved for Supervisor(s) [-] 420.16 W
Power reserved for Fan Module(s) [-] 210.00 W
Power currently used by Modules [-] 801.82 W
-----
Total Power Available              899.02 W
-----

```



**Figure 2. Switch Configuration After Upgrade**

**After – 240 ports**

```

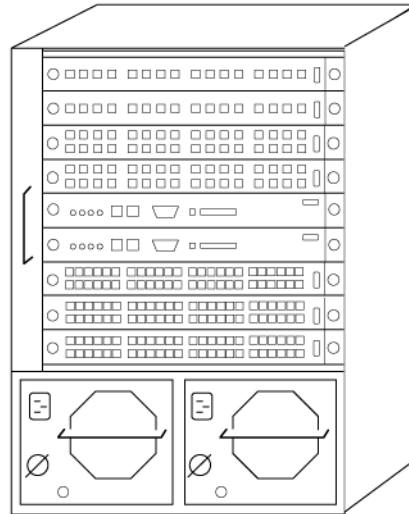
MDS# show environment power
-----
PS Model                Power      Power      Status
   (Watts)      (Amp @42V)
-----
1  DS-CAC-2500W        2331.00   55.50     ok
2  DS-CAC-2500W        2331.00   55.50     ok

Mod Model                Power      Power
   Requested Requested
   (Watts)      (Amp @42V)
-----
1  DS-X9016             210.08    5.00
2  DS-X9016             210.08    5.00
3  DS-X9032             190.83    4.54
4  DS-X9032             190.83    4.54
5  DS-X9530-SF1-K9      210.08    5.00
6  DS-X9530-SF1-K9      210.08    5.00
7  DS-X9148             185.00    4.40
8  DS-X9148             185.00    4.40
9  DS-X9148             185.00    4.40

Power Usage Summary:
-----
Power Supply redundancy mode:      redundant
Total Power Capacity                2331.00 W
Power reserved for Supervisor(s)[-]  420.16 W
Power reserved for Fan Module(s)[-]  210.00 W
Power currently used by Modules[-]   1356.82 W

Total Power Available                344.02 W
-----

```



- Q&A**
- Q.** Do I need to upgrade to a Supervisor-2 to support the newer linecards in my existing chassis?
- A.** There is no need to upgrade to Supervisor-2 to support newer linecard modules. Supervisor-1 with Cisco MDS 9000 SAN-OS Software Release 3.0 or later supports second-generation linecard modules.
- Q.** Can I insert first-generation linecards into a Cisco MDS 9513 Supervisor-2?
- A.** Yes. All first-generation linecard modules are supported on Cisco MDS 9513 Supervisor-2. The only limitation is that a switch with a first-generation linecard module or Supervisor-1 is limited to a maximum port density of 252 usable ports.
- Q.** What intelligent features do I lose on second-generation linecard modules when I use them in a chassis with Supervisor-1?
- A.** None. All the Cisco MDS features are the same irrespective of the type and generation of the modules used.
- Q.** What happens if I try to exceed 252 ports in a chassis with a first-generation linecard module or Supervisor-1?
- A.** Nothing happens. Any linecard inserted into the system that would cause the system to exceed 252 ports will not be powered up.
- Q.** If I use only second-generation linecard modules and Supervisor-2, what is the maximum port density?
- A.** Cisco MDS 9513 with 11 48-port linecard modules provides 528 1/2/4-Gbps Fibre Channel ports in a single 14-rack unit (RU) chassis. Cisco MDS 9509 with Supervisor-2 and 7 48-port linecard modules provides up to 336 1/2/4-Gbps Fibre Channel ports in a single 14-RU chassis. Cisco MDS 9506 with Supervisor-2 and 4 48-port linecard modules provides up to 192 1/2/4-Gbps Fibre Channel ports in a single 7-RU chassis.
- Q.** Can I mix 1/2-Gbps Fibre Channel, IP services (IPS), multiprotocol services (MPS), and Storage Services Modules (SSM) with newer 1/2/4-Gbps and 10-Gbps Fibre Channel modules in the same chassis?
- A.** Yes. First-generation and second-generation linecard modules can be intermixed.

**Q.** Do modules have to be installed in any order in the chassis—for example, older modules first?

**A.** There are no restrictions on the order in which modules must be installed.

**Q.** Do I need to upgrade my 2500W power supply to a 3000W or 4000W power supply to handle the newer modules?

**A.** No. Because of improvements in silicon technology, the power requirements have actually decreased 33 percent to 50 percent on a per-port basis, depending on the type of port and linecard. Although second-generation linecards provide up to a 50 percent higher port density compared to first-generation linecard modules, power requirements are approximately the same, and for the vast majority of deployments, existing 1900W and 2500W power supplies offer more than sufficient power and headroom for future modules.

## CONCLUSION

Cisco continues to elevate the standard for multiprotocol intelligent SAN switches. Providing industry-leading availability, scalability, security, management, and investment protection, Cisco MDS 9000 Family switches allow you to deploy high-performance SANs with low total cost of ownership, layering a rich set of intelligent features onto a high-performance, protocol-independent switch fabric.



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