

Solutions Products Ordering Support Partners Training Corporate

Tech Notes

Understanding the Catalyst 6500 Switch Fabric Module with Supervisor Engine 2

[TAC Notice: What's Changing on TAC Web](#)

Contents

[Introduction](#)

[Prerequisites](#)

[Requirements](#)

[Components Used](#)

[Conventions](#)

[Background Information](#)

[Difference Between CatOS and Cisco IOS System Software](#)

[Switch Fabric Architecture](#)

[Switch Fabric Module Modes of Operation](#)

[BUS-Only or Flow-Through Mode](#)

[Truncated Mode](#)

[Compact Mode](#)

[Distributed Cisco Express Forwarding Mode](#)

[Summary](#)

[Switching Fabric Redundancy](#)

[Data BUS Fallback Redundancy](#)

[Switch Fabric Module Redundancy](#)

[Types of Fabric-Enabled Modules](#)

[Connection to Both the Data BUS and Switch Fabric](#)

[Connection to the Switch Fabric Only](#)

[Frequently Asked Questions](#)

[NetPro Discussion Forums - Featured Conversations](#)

[Related Information](#)

Help us help you.

Please rate this document.

Excellent

Good

Average

Fair

Poor

This document solved my problem.

Yes

No

Just browsing

Suggestions for improvement:

(256 character limit)

Introduction

The Cisco Catalyst 6500 series switch fabric modules (SFM), including the Switch Fabric Module 2 (WS-X6500-SFM2) and the Switch Fabric Module (WS-C6500-SFM), in combination with the Supervisor Engine 2, deliver an increase in available system bandwidth from the existing 32 Gbps to 256 Gbps. SFM is not supported on Supervisor Engine I-based systems. The Switch Fabric Module 2 and the Switch Fabric Module enable an architecture that allows 30 million packets per second (Mpps) of Cisco Express Forwarding-based central forwarding performance on Supervisor Engine 2 and up to 210 Mpps of distributed forwarding performance. The Distributed Feature Daughter Card (WS-F6K-

DFC) is required to be installed on the line cards to deliver up to 210 Mpps of distributed forwarding.

This document describes the different modes of operation of the SFM, the types of fabric-enabled modules, and frequently asked questions concerning the SFM.

Prerequisites

Requirements

There are no specific prerequisites for this document.

Components Used

The information in this document is based on these software and hardware versions:

- Switch Fabric Module WS-C6500-SFM
- Switch Fabric Module WS-C6500-SFM2

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

Conventions

Refer to [Cisco Technical Tips Conventions](#) for more information on document conventions.

Background Information

There are two types of SFMs available for Supervisor Engine 2.

The WS-C6500-SFM can only work in a Catalyst 6506, Catalyst 6509, Cisco 7606, and Cisco 7609 chassis and is inserted in either slot 5 or slot 6. The WS-C6500-SFM is **not** supported on a Catalyst 6513.

The WS-C6500-SFM2 can work in a Catalyst 6506, Catalyst 6509, Catalyst 6513, Cisco 7606, and Cisco 7609 chassis. On a Catalyst 6506, Cisco 7609, Cisco 7609, or Catalyst 6509 chassis, the WS-C6500-SFM2 is inserted into slot 5 or slot 6. On a Catalyst 6513, the WS-C6500-SFM2 is inserted into slot 7 or slot 8.

Switching fabric redundancy is supported on both the WS-C6500-SFM and WS-C6500-SFM2. If two SFMs are inserted into the chassis, the SFM in the higher slot number acts as a redundant SFM. Only one SFM can be active at any one time. If the active SFM fails, the standby SFM becomes the active SFM. For redundancy, the two SFMs must have the same part number.

This table summarizes the minimum code requirements and supported chassis configuration for the SFM:

--	--	--	--

	Minimum Code Requirement		Supported Chassis			Switch Fabric Module Redundancy
	Catalyst OS (CatOS)	Cisco IOS® Software Release	Catalyst 6506 and 6509	Cisco 7606 and 7609	Catalyst 6513	
WS-C6500-SFM	6.1(1d)	12.1(8b) E9	Yes	Yes	No	Supported
WS-C6500-SFM2	6.2(2)	12.1(8b) E9	Yes	Yes	Yes	Supported

Difference Between CatOS and Cisco IOS System Software

CatOS on the Supervisor Engine and Cisco IOS Software on the MSFC (Hybrid): a CatOS image can be used as the system software to run the Supervisor Engine on Catalyst 6500/6000 switches. If the optional Multilayer Switch Feature Card (MSFC) is installed, a separate Cisco IOS Software image is used to run the MSFC.

Cisco IOS Software on both the Supervisor Engine and MSFC (Native): a single Cisco IOS Software image can be used as the system software to run both the Supervisor Engine and MSFC on Catalyst 6500/6000 switches.

Note: For more information, refer to [Comparison of the Cisco Catalyst and Cisco IOS Operating Systems for the Cisco Catalyst 6500 Series Switch](#).

Switch Fabric Architecture

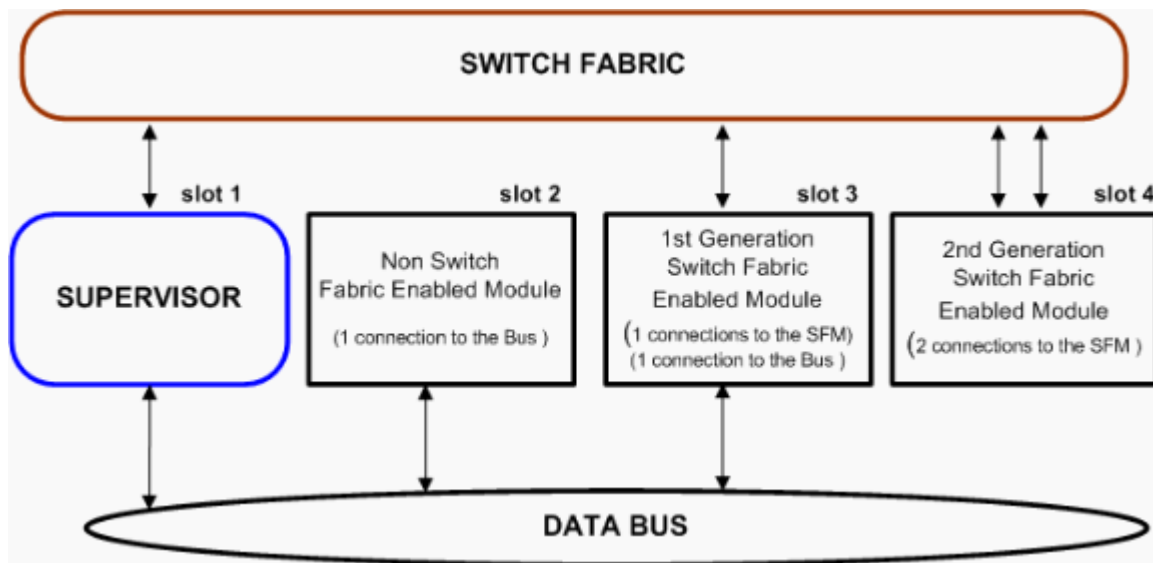
The example in this section illustrates a logical diagram of a Catalyst 6509. The diagram shows the interconnections between a Supervisor Engine in slot 1, a nonswitch fabric-enabled module in slot 2, one fabric channel switch fabric-enabled module (for example, WS-X6516=) in slot 3, a dual fabric channel switch fabric-enabled module (for example, WS-X6816=) in slot 4, and a SFM in slot 5.

The switch fabric is comprised of the SFM and connecting components located on the Catalyst 6500 chassis. The dual fabric channel switch fabric-enabled module has connections to the switch fabric only.

Switch fabric-enabled modules with one fabric channel have one connection to the Data BUS and one connection to the switch fabric.

The Supervisor Engine, nonfabric-enabled module, and switch fabric-enabled module with one fabric channel have a connection to the Data BUS.

The Data BUS has a lower data forwarding capacity (32 Gbps) than the switch fabric (256 Gbps), and all data going to and from the nonfabric-enabled modules must traverse the Data BUS.



Switch Fabric Module Modes of Operation

The SFM creates a dedicated channel between the fabric-enabled module and the SFM, and provides uninterrupted transmission of frames between these modules.

This table is a summary of the different flows:

Data Flow Between Modules	Mode of Operation in Cisco IOS Software	Mode of Operation in CatOS
Between fabric-enabled modules (no nonfabric-enabled modules installed)	Compact	Compact
Between fabric-enabled modules (when nonfabric-enabled modules are also installed)	Truncated	Truncated
Between fabric-enabled and nonfabric-enabled modules	BUS	Flow-through
Between nonfabric-enabled module	BUS	Flow-through
Fabric-enabled modules with the Distributed Feature Card (DFC) installed	Distributed Cisco Express Forwarding (dCEF)	N/A

With the SFM, the traffic is forwarded to and from the modules in the modes described in this section. The mode of operation determines the flow of data through the switch.

BUS-Only or Flow-Through Mode

A Catalyst 6500 with a SFM and nonfabric-enabled modules like the WS-X6348-RJ-45 or WS-X6416-GBIC work in flow-through mode. In flow-through mode, data flowing between nonfabric-enabled modules do not use the SFM, but the 32 Gbps Data BUS. Data flowing between a Supervisor Engine/MSFC and a nonfabric-enabled module also traverse the Data BUS and do not use the SFM. Data flowing between a module with no connections to the Data BUS, like the WS-X6816-GBIC, and a nonfabric-enabled module traverse from the switch fabric-enabled module through the SFM, then to the Supervisor Engine, and then to the nonfabric module.

Truncated Mode

When the switch contains a fabric-enabled module and a nonfabric-enabled module, the fabric-enabled line cards operate in truncated mode. In this mode, the traffic between the fabric-capable module and the nonfabric modules goes through the switch fabric channel and the Data BUS through the Supervisor Engine. In the case of traffic between fabric-enabled modules, only the truncated data (the first 64 bytes of the frame) are sent over the switch fabric channel. In the case of traffic between two nonfabric-enabled modules, it acts like the flow-through mode.

You can manually specify which switching mode the system uses to improve performance by analyzing the data packets. The default mode should work well, unless another mode is needed for specific reasons. If you have nonfabric-enabled and fabric-enabled modules in the chassis, and most of the traffic is between the fabric-enabled and nonfabric-enabled module, then there is greater advantage in using BUS-mode than truncated mode. With most of the packets flowing between fabric-enabled modules, especially the jumbo-size frames, truncated mode is preferred. You can configure the threshold for the truncated mode with this command in the Cisco IOS Software:

```
fabric switching-mode allow {bus-mode | {truncated [{threshold [number]}]}}
```

In this command, the threshold *number* is the number of the fabric-enabled line card before the truncated mode is enabled.

Compact Mode

When a chassis contains only switch fabric-enabled modules, the fabric-enabled line cards can run in compact mode. This delivers the best possible switching rate in CatOS, depending on the line cards.

Distributed Cisco Express Forwarding Mode

This mode is only available in the Cisco IOS Software with the fabric-enabled line cards that have a DFC. This delivers the best possible Layer 3 switching rate in Cisco IOS Software.

Summary

The overall data forwarding capacity of the switch increases as more traffic uses SFM than the Data BUS. BUS-only or flow-through mode has the lowest data forwarding capacity, and compact mode has

the highest data forwarding capacity when using CatOS. The dCEF mode has the highest forwarding capacity on a Catalyst 6500 using Cisco IOS Software.

In CatOS, it is possible to disable the switch capability to revert to BUS-only mode when the SFM fails using the **set system cross-fallback** command. If the switch reverts to BUS-only mode, modules that have a connection to the BUS continue to function while modules with no connection to the BUS are powered down by the Supervisor Engine.

The mode of operation is automatically set by the Supervisor Engine, but can be configured if needed.

In Cisco IOS Software Release 12.1.11E and later, you can configure the switching mode by using this command:

- **[no] fabric switching-mode allow {bus-mode | {truncated [{threshold [number]}]}}**

The **no fabric switching-mode allow bus-mode** command removes the power to all the nonfabric modules.

If you specify truncated mode, the switch operates in the truncated mode if it has even one fabric-enabled module present in the chassis with other nonfabric modules.

In truncated mode, you can also specify the number of fabric-enabled modules that need to be present in the chassis to change to truncated mode with the **threshold** command. The default is two. If the threshold is not met, the mode falls back to the original mode.

The **show fabric switching-mode** command is used to verify the mode of operation, as shown here:

```
cat6k# show fabric switching-mode
%Truncated mode is allowed
%System is allowed to operate in legacy mode

Module Slot      Switching Mode
-----
1               Crossbar
2               DCEF
3               DCEF
4               DCEF
5               No Interfaces
```

A similar command exists in CatOS, but you cannot specify the threshold value with the truncated mode at this point.

- **set system switchmode allow {truncated | bus-only}**

The reason to have these thresholds is to improve performance. In truncated mode, the traffic from fabric-capable to nonfabric-capable module needs to travel Fabric and Data BUS, which impacts the overall performance. When BUS-only and fabric-capable cards are mixed in the same chassis, you may want to weigh their traffic patterns and see if there is any benefit in using the truncated mode. The default mode should serve best, but overall performance may be better in truncated mode if there is a lot of traffic with big frame sizes (or jumbos) between a Supervisor Engine and a single fabric-capable card (or between ports on the same fabric-capable card).

The **show fabric channel switchmode** command is used to verify the operation mode, as shown here:

```
cat6k> (enable) show fabric channel switchmode
Global switching mode: flow through
```

Module	Num	Fab	Chan	Fab	Chan	Switch Mode	Channel Status
1			1	0,	0	flow through	unused
3			0	n/a	n/a	n/a	n/a
5			1	0,	5	flow through	unused
6			18	0,	0	n/a	unused
6			18	1,	1	n/a	unused
6			18	2,	2	n/a	unused
6			18	3,	3	n/a	unused
6			18	4,	4	n/a	unused
6			18	5,	5	n/a	unused
6			18	6,	6	n/a	unused
6			18	7,	7	n/a	unused
6			18	8,	8	n/a	unused
6			18	9,	9	n/a	unused
6			18	10,	10	n/a	unused
6			18	11,	11	n/a	unused
6			18	12,	12	n/a	unused
6			18	13,	13	n/a	unused
6			18	14,	14	n/a	unused
6			18	15,	15	n/a	unused
6			18	16,	16	n/a	unused
6			18	17,	17	n/a	unused

Switching Fabric Redundancy

Data BUS Fallback Redundancy

The first generation of the fabric-enabled line cards (for example, WS-X6516-GBIC) provides a connection to both the switching fabric as well as the existing system BUS. This allows the Catalyst 6500 system to use the switching fabric as the primary means of data transfer for fabric-enabled line cards. If the switch fabric fails, the system BUS backplane takes over to ensure that packet switching continues, although at 15 Mpps, and the switch remains on line.

Note: This change in switching performance is applicable only if the system is initially forwarding at greater than 15 Mpps. If a system is running at 15 Mpps, the fabric-to-system BUS failover does not affect performance. Active fabric-to-standby fabric and active fabric-to-32-Gbps backplane failovers recover to normal operation in under three seconds.

Switch Fabric Module Redundancy

Additionally, the Catalyst 6500 series can be configured with dual SFMs (for example, in slots 5 and 6), which provide another level of fabric redundancy. In this configuration, a failure on the primary fabric module would result in a switchover to the secondary fabric module for continued operation at 30 Mpps.

The active switch fabric module fails over to the secondary switch fabric in this scenario:

1. The active SFM failed, is disabled, or is removed from the chassis.

2. All the fabric-enabled modules at the time of boot synchronize the channel with the standby and then the active (given when both SFMs are present). If any of the SFM module fails to synchronize, that SFM module is disabled.
3. If the fabric-enabled module or the SFM experiences any kind of error, loss of synchronization, cyclic redundancy check (CRC) error, heartbeat timeout, or other problem and exceeds the threshold value, the module reports this to the Supervisor Engine. The Supervisor Engine starts initiating the recovery process by resetting the channel. If the synchronization failed with the active, but is successful with the standby, the active is disabled. If it failed with the active, the module is disabled.
4. If the Supervisor Engine itself or the SFM experiences the same kinds of errors, such as CRC or heartbeat loss on the channel, and exceeds the threshold value, the Supervisor Engine tries to synchronize with the standby. If successful, it disables the active. If unsuccessful, both SFMs are disabled, and it operates without the SFMs.

Note: Second-generation switch fabric-enabled modules work only in the presence of a SFM. If there are no SFMs in a chassis with second-generation switch fabric-enabled modules, the modules do not function.

Types of Fabric-Enabled Modules

Connection to Both the Data BUS and Switch Fabric

These modules have a single serial channel to the switch fabric and a connection to the Data BUS. These modules can function in a chassis, with or without a SFM:

- WS-X6K-S2-MSFC2 and WS-X6K-S2-PFC2
- WS-X6516-GBIC
- WS-X6502-C10GE
- WS-X6548-RJ-45
- WS-X6548-RJ-21
- WS-X6516-GE-TX
- WS-X6524-MT-RJ

Connection to the Switch Fabric Only

This module has dual serial channels to the switch fabric and does not have a connection to the Data BUS. Without an operational SFM in the chassis, the module does not function:

- WS-X6816-GBIC

Frequently Asked Questions

Q1: The switch is producing the error message "Invalid Feature index set for module X" when the SFM is inserted.

This message is produced by a switch running CatOS. It means that the code running on the switch does not support the installed SFM. The minimum code requirement for the WS-C6500-SFM is 6.1(1d), and the minimum code requirement for the WS-C6500-SFM2 is 6.2(2).

Q2: Do nonswitch fabric-enabled line cards work with a SFM in the chassis?

Nonswitch fabric-enabled cards do not utilize the switch fabric, but they do work and use the switching BUS for data forwarding. In this case, the SFM operates in either truncated or BUS-only mode, depending on the presence of other fabric-enabled modules.

Q3: Does the Supervisor Engine 1 (WS-X6K-SUP1-2GE) or Supervisor Engine 1A (WS-X6K-SUP1A-2GE) support a SFM?

The SFM only works with a Supervisor Engine 2. The SFM cannot function in a chassis with a Supervisor Engine 1 or 1A.

Q4: Does the SFM module work in a Catalyst 6000 chassis?

The SFM only functions in a Catalyst 6500 chassis. The Catalyst 6000 chassis does not have the hardware support for the switch fabric.

Q5: What is the difference between the WS-C6500-SFM and WS-C6500-SFM2?

The WS-C6500-SFM can only support up to eight fabric-enabled modules. For this reason, the WS-C6500-SFM can only function in a 6-slot or 9-slot 6500 chassis. The WS-C6500-SFM2 can support 11 fabric modules and functions in the 6-slot, 9-slot and 13-slot chassis.

Note: All line card slots in a 6-slot or 9-slot chassis have dual fabric channels. A 13-slot chassis, on the other hand, only has dual fabric channels in slots 9 through 13. Make sure to insert dual fabric-enabled modules into the correct dual fabric slots for each chassis.

Q6: What are the differences between a fabric-capable module and a fabric-only module?

This table provides a list of some of the differences between a fabric-capable module and a fabric-only module:

Characteristics	Fabric Capable Modules	Fabric Only Modules
Model Numbers	Begin with WS-X65XX	Begin with WS-X68XX
Number of Connections to Switch Fabric	one	two

Number of Connections to Data BUS	one	zero
Supports Data BUS Fallback Redundancy	Yes. It has a connection to the Data BUS. If the SFM is removed from the chassis, the card continues to function.	No. This module only connects to the SFM. Without the SFM, the card is powered off and ceases to function until a SFM is inserted into the chassis.
Comes Standard with DFC	No. A DFC must be purchased separately.	A DFC module comes with each module.

Q7: Does a SFM-capable module require a DFC daughter card to use the switch fabric?

A DFC allows a module to support dCEF. The dCEF is the ability for a module to make routing decisions independent of the Supervisor Engine or MSFC2. Similar to the Cisco 7500 Versatile Interface Processor (VIP), the DFC works by replicating Layer 2 (L2) and Layer 3 (L3) forwarding logic from the Supervisor Engine and MSFC2, thereby allowing the module to make a L2 or L3 forwarding decision locally on the module. The DFC is only supported in Cisco IOS Software. The DFC card is a further enhancement and, in combination with the SFM, can increase the data forwarding capacity to 210 Mpps.

NetPro Discussion Forums - Featured Conversations

Networking Professionals Connection is a forum for networking professionals to share questions, suggestions, and information about networking solutions, products, and technologies. The featured links are some of the most recent conversations available in this technology.

NetPro Discussion Forums - Featured Conversations for LAN
Network Infrastructure: LAN Routing and Switching
Etherchannel and trunk - Mar 18, 2008 3550 switches - sulphur smell - Mar 18, 2008 SLB Help Needed - Mar 18, 2008 ip conflict. - Mar 18, 2008 etherchannel - Mar 18, 2008
Network Infrastructure: Getting Started with LANs
Conecting a 2600 to host via crossover - Mar 18, 2008 connections x-over and straight through - Mar 17, 2008 Connecting to ISP through calbe modem and Cisco 871 - Mar 17, 2008 subnet question - Mar 17, 2008 D-LINK switch giving me problems on my NETWORK, solve my problem for me - Mar 17, 2008

Related Information

- [Configuring the Switch Fabric Modules](#)
- [LAN Product Support](#)
- [LAN Switching Technology Support](#)
- [Technical Support & Documentation - Cisco Systems](#)

Home	How to Buy	Login	Profile	Feedback	Site Map	Help
----------------------	----------------------------	-----------------------	-------------------------	--------------------------	--------------------------	----------------------

[Contacts & Feedback](#) | [Help](#) | [Site Map](#)

© 2007 - 2008 Cisco Systems, Inc. All rights reserved. [Terms & Conditions](#) | [Privacy Statement](#) | [Cookie Policy](#) | [Trademarks of Cisco Systems, Inc.](#)