Cisco 7600 Series Router Miscellaneous Services Module Installation Guide

December 2012

THE SPECIFICATIONS AND INFORMATION REGARDING THE PRODUCTS IN THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE. ALL STATEMENTS, INFORMATION, AND RECOMMENDATIONS IN THIS MANUAL ARE BELIEVED TO BE ACCURATE BUT ARE PRESENTED WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. USERS MUST TAKE FULL RESPONSIBILITY FOR THEIR APPLICATION OF ANY PRODUCTS.

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

Text Part Number: OL-9392-05
THE SOFTWARE LICENSE AND LIMITED WARRANTY FOR THE ACCOMPANYING PRODUCT ARE SET FORTH IN THE INFORMATION PACKET THAT SHIPPED WITH THE PRODUCT AND ARE INCORPORATED HEREIN BY THIS REFERENCE. IF YOU ARE UNABLE TO LOCATE THE SOFTWARE LICENSE OR LIMITED WARRANTY, CONTACT YOUR CISCO REPRESENTATIVE FOR A COPY.

The following information is for FCC compliance of Class A devices: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case users will be required to correct the interference at their own expense.

The following information is for FCC compliance of Class B devices: The equipment described in this manual generates and may radiate radio-frequency energy. If it is not installed in accordance with Cisco’s installation instructions, it may cause interference with radio and television reception. This equipment has been tested and found to comply with the limits for a Class B digital device in accordance with the specifications in part 15 of the FCC rules. These specifications are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation.

Modifying the equipment without Cisco’s written authorization may result in the equipment no longer complying with FCC requirements for Class A or Class B digital devices. In that event, your right to use the equipment may be limited by FCC regulations, and you may be required to correct any interference to radio or television communications at your own expense.

You can determine whether your equipment is causing interference by turning it off. If the interference stops, it was probably caused by the Cisco equipment or one of its peripheral devices. If the equipment causes interference to radio or television reception, try to correct the interference by using one or more of the following measures:

- Turn the television or radio antenna until the interference stops.
- Move the equipment to one side or the other of the television or radio.
- Move the equipment farther away from the television or radio.
- Plug the equipment into an outlet that is on a different circuit from the television or radio. (That is, make certain the equipment and the television or radio are on circuits controlled by different circuit breakers or fuses.)

Modifications to this product not authorized by Cisco Systems, Inc. could void the FCC approval and negate your authority to operate the product.

The Cisco implementation of TCP header compression is an adaptation of a program developed by the University of California, Berkeley (UCB) as part of UCB’s public domain version of the UNIX operating system. All rights reserved. Copyright © 1981, Regents of the University of California.

NOTWITHSTANDING ANY OTHER WARRANTY HEREIN, ALL DOCUMENT FILES AND SOFTWARE OF THESE SUPPLIERS ARE PROVIDED “AS IS” WITH ALL FAULTS. CISCO AND THE ABOVE-NAMED SUPPLIERS DISCLAIM ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THOSE OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OR ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE.

IN NO EVENT SHALL CISCO OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR LOSS OR DAMAGE TO DATA ARISING OUT OF THE USE OR INABILITY TO USE THIS MANUAL, EVEN IF CISCO OR ITS SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: www.cisco.com/go/trademarks. Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1110R)

Any Internet Protocol (IP) addresses used in this document are not intended to be actual addresses. Any examples, command display output, and figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses in illustrative content is unintentional and coincidental.

Cisco 7600 Series Router Miscellaneous Services Module Installation Guide
© 2006-12 Cisco Systems, Inc. All rights reserved.
CONTENTS

Preface ix

Audience ix

Document Revision History ix

Organization ix

Conventions x

Warning Definition xii

Related Documentation xv

Obtaining Documentation and Submitting a Service Request xvi

CHAPTER 1 Modules Overview 1-1

LEDs 1-1

Port Addresses 1-2

- Physical Interface Addresses 1-2
- MAC Addresses 1-3

Hot Swapping Modules 1-4

Power Management and Environmental Monitoring 1-4

Limiting Connection Distances 1-4

Port Connector Requirements 1-5

Port Densities 1-6

Gigabit Interface Converters 1-7

- WS-G5483 Copper GBIC 1-8
- WS-G5484, WS-G5486, and WS-G5487 Optical GBICs 1-9
- Coarse Wave Division Multiplexing GBICs 1-9
- SFP Optical Transceiver Modules 1-10
- 1000BASE-T SFP Transceiver Modules 1-11
- CWDM SFP Optical Transceiver Modules 1-11
- XenPak Optical Transceiver Modules 1-12

Software Requirements 1-13

CHAPTER 2 Ethernet and Gigabit Ethernet Switching Modules 2-15

10/100 and 10/100/1000 Ethernet Switching Modules 2-15

- 24-Port 10BASE-FL Ethernet Switching Module (WS-X6024-10FL-MT) 2-18
- 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148-GE-TX) 2-18
48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148V-GE-TX)  2-18
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ21V)  2-19
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ45V)  2-20
24-Port 100BASE-FX Ethernet Switching Module (WS-X6224-100FX-MT)  2-20
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-RJ45)  2-21
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248A-TEL)  2-21
24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-MM)  2-22
24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-SM)  2-22
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ21V)  2-23
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ-45)  2-23
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ45V)  2-24
48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548-GE-TX)  2-25
48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548V-GE-TX)  2-25
48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ21V)  2-26
48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-45)  2-26
48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ45V)  2-24
24-Port 100BASE-FX Fabric-Enabled Ethernet Switching Module (WS-X6524-100FX-MM)  2-24
48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6748-GE-TX)  2-27

Gigabit Ethernet Switching Modules  2-27
16-Port Gigabit Ethernet Switching Module (WS-X6316-GE-TX)  2-29
8-Port Gigabit Ethernet Switching Module (WS-X6408-GBIC)  2-29
8-Port Gigabit Ethernet Switching Module (WS-X6408A-GBIC)  2-29
16-Port Gigabit Ethernet Switching Module (WS-X6416-GBIC)  2-30
16-Port Gigabit Ethernet Switching Module (WS-X6416-GE-MT)  2-30
1-Port 10-Gigabit Ethernet Module (WS-X6501-10GEX4)  2-31
1-Port 10-Gigabit Ethernet Base Module (WS-X6502-10GE)  2-31
16-Port Gigabit Ethernet Switching Module (WS-X6516-GBIC)  2-31
16-Port Gigabit Ethernet Switching Module (WS-X6516A-GBIC)  2-32
16-Port 10/100/1000BASE-T Gigabit Ethernet Switching Module (WS-X6516-GE-TX)  2-32
4-Port 10 Gigabit Ethernet Switching Module (WS-X6704-10GE)  2-33
24-Port Gigabit Ethernet Switching Module (WS-X6724-SFP)  2-33
48-Port Gigabit Ethernet Switching Module (WS-X6748-SFP)  2-33
16-Port Gigabit Ethernet Switching Module (WS-X6816-GBIC)  2-34
8-Port Gigabit Ethernet Switching Module (WS-X6708-10G-3C)  2-34
8-Port Gigabit Ethernet Switching Module (WS-X6708-10G-3CXL)  2-35

Ethernet Module LEDs  2-35

CHAPTER 3
ATM Modules  3-1

1-Port OC-12 ATM Module (WS-X6101-OC12-MMF)  3-1
CHAPTER 16

Adaptive Security Appliance Services Module 16-1

Functional Overview of Firewalls 16-1

ASA SM Overview 16-2

ASA SM Front Panel LEDs 16-2

ASA SM Support 16-2

Support for ASA SM 16-3

Support on ASA SM 16-3

Deployment of ASA SM 16-4

ASA SM Firewall Modes 16-4

Routed Mode 16-4

Transparent Mode 16-4

Security Context Overview 16-5

ASA SM Failover Mechanism 16-5

Active-Active failover 16-5

Active-Standby failover 16-5

Support on Chassis 16-5

Restrictions and Configuration 16-6

Restrictions 16-6

ASA Configuration 16-6

Troubleshooting 16-6

Debug commands 16-7

ASA SM Documentation 16-7

APPENDIX A

Technical Specifications A-1

Module Specifications A-1

Regulatory Standards Compliance A-1

APPENDIX B

Translated Safety Warnings B-1

Safety Information Referral Warning B-1

Wrist Strap Warning B-2

Blank Faceplate Installation Requirement Warning B-3

EU Public Network Port Warning B-5
Preface

This preface describes who should read the Cisco 7600 Series Router Miscellaneous Services Module Installation Guide, how it is organized, and its document conventions.

Audience

Only trained and qualified service personnel (as defined in IEC 60950 and AS/NZS3260) should install, replace, or service the equipment described in this publication.

Document Revision History

The Document Revision History table below records technical changes to this document. The table shows the document revision number for the change, the date of the change, and a brief summary of the change. Note that not all Cisco documents use a Document Revision History table.

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Change Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>OL-9302-05</td>
<td>December 2012</td>
<td>Added Adaptive Security Appliance (ASA) module</td>
</tr>
<tr>
<td>OL-9302-04</td>
<td>October 2008</td>
<td>Added ES+ line cards</td>
</tr>
<tr>
<td>OL-9302-03</td>
<td>January 2008</td>
<td>Added 8-Port Gigabit Ethernet Switching Modules</td>
</tr>
<tr>
<td>OL-9302-02</td>
<td>February 2007</td>
<td>Added:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ethernet Services 20G (ES20) line cards</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Application Control Engine (ACE) module</td>
</tr>
<tr>
<td>OL-9302-01</td>
<td>June, 2006</td>
<td>Initial release</td>
</tr>
</tbody>
</table>

Organization

This publication is organized as follows:
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Modules</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Modules Overview</td>
<td>Provides an overview of the Cisco 7600 series routers modules.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ethernet and Gigabit Ethernet Switching Modules</td>
<td>Describes the Ethernet and Gigabit Ethernet switching modules and provides LED descriptions for these modules.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ATM Modules</td>
<td>Describes the ATM modules and provides LED descriptions for these modules.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FlexWAN Module and Enhanced FlexWAN Modules</td>
<td>Describes FlexWAN and Enhanced FlexWAN Modules.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multilayer Switch Module</td>
<td>Describes the Multilayer Switch Module (MSM).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Network Analysis Modules</td>
<td>Describes the Network Analysis Modules (NAMs).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Firewall Services Module</td>
<td>Describes the Firewall Services Module.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IPSec VPN Acceleration Services Module</td>
<td>Describes IPSec VPN Acceleration Services Module.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intrusion Detection System Module</td>
<td>Describes the Intrusion Detection System Module.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Content Switching Module</td>
<td>Describes the Content Switching Module.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Switch Fabric Modules</td>
<td>Describes the Switch Fabric Modules.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Voice-Related Modules</td>
<td>Describes the voice-related modules.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cisco 7600 Series Ethernet Services 20G Line Cards</td>
<td>Describes the Ethernet Services 20G Line Cards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cisco Application Control Engine Module</td>
<td>Describes Application Control Engine Module.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cisco 7600 Ethernet Services Plus Line Cards</td>
<td>Describes the ES+ line cards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Specifications</td>
<td>Lists the Technical Specifications.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Translated Safety Warnings</td>
<td>Provides procedures for upgrading the memory on the OSMs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Translated Safety Warnings</td>
<td>Lists the translated safety warnings.</td>
</tr>
</tbody>
</table>

## Conventions

This publication uses the following conventions:

<table>
<thead>
<tr>
<th>Convention</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>boldface</strong> font</td>
<td>Commands, command options, and keywords are in <strong>boldface</strong>.</td>
</tr>
<tr>
<td><em>italic</em> font</td>
<td>Arguments for which you supply values are in <em>italics</em>.</td>
</tr>
<tr>
<td>[ ]</td>
<td>Elements in square brackets are optional.</td>
</tr>
<tr>
<td>Convention</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>{ x y</td>
<td>z }</td>
</tr>
<tr>
<td>[ x y</td>
<td>z ]</td>
</tr>
<tr>
<td>string</td>
<td>A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.</td>
</tr>
<tr>
<td>screen font</td>
<td>Terminal sessions and information the system displays are in screen font.</td>
</tr>
<tr>
<td>boldface screen font</td>
<td>Information you must enter is in boldface screen font.</td>
</tr>
<tr>
<td>italic screen font</td>
<td>Arguments for which you supply values are in italic screen font.</td>
</tr>
<tr>
<td>^</td>
<td>The symbol ^ represents the key labeled Control. For example, the key combination ^D in a screen display means hold down the Control key while you press the D key.</td>
</tr>
<tr>
<td>&lt; &gt;</td>
<td>Nonprinting characters, such as passwords, are in angle brackets.</td>
</tr>
</tbody>
</table>

Notes use the following conventions:

**Note**

Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the publication.

Cautions use the following conventions:

**Caution**

Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.
Warning Definition

**Warning**

**IMPORTANT SAFETY INSTRUCTIONS**

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device. Statement 1071

**SAVE THESE INSTRUCTIONS**
Warnung  WICHTIGE SICHERHEITSHINWEISE


BEWAHREN SIE DIESE HINWEISE GUT AUF.

Avvertenza  IMPORTANTI ISTRUZIONI SULLA SICUREZZA

Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di intervenire su qualsiasi apparecchiatura, occorre essere al corrente dei pericoli relativi ai circuiti elettrici e conoscere le procedure standard per la prevenzione di incidenti. Utilizzare il numero di istruzione presente alla fine di ciascuna avvertenza per individuare le traduzioni delle avvertenze riportate in questo documento.

CONSERVARE QUESTE ISTRUZIONI

Advarsel  VIKTIGE SIKKERHETSINSTRUKSJONER

Dette advarselssymbolet betyr fare. Du er i en situasjon som kan føre til skade på person. Før du begynner å arbeide med noe av utstyr, må du være oppmerksom på farene forbundet med elektriske kretser, og kjenne til standardprosedyrer for å forhindre ulykker. Bruk nummeret i slutten av hver advarsel for å finne oversettelsen i de oversatte sikkertshedsadvarslene som fulgte med denne enheten.

TA VARE PÅ DISSE INSTRUKSJONENE

Aviso  INSTRUÇÕES IMPORTANTES DE SEGURANÇA

Este símbolo de aviso significa perigo. Você está em uma situação que poderá ser causadora de lesões corporais. Antes de iniciar a utilização de qualquer equipamento, tenha conhecimento dos perigos envolvidos no manuseio de circuitos elétricos e familiarize-se com as práticas habituais de prevenção de acidentes. Utilize o número da instrução fornecido ao final de cada aviso para localizar sua tradução nos avisos de segurança traduzidos que acompanham este dispositivo.

GUARDE ESTAS INSTRUÇÕES

¡Advertencia!  INSTRUCCIONES IMPORTANTES DE SEGURIDAD

Este símbolo de aviso indica peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considere los riesgos de la corriente eléctrica y familiarícese con los procedimientos estándar de prevención de accidentes. Al final de cada advertencia encontrará el número que le ayudará a encontrar el texto traducido en el apartado de traducciones que acompaña a este dispositivo.

GUARDE ESTAS INSTRUCCIONES
Warning!  VIKTIGA SÄKERHETSANVISNINGAR


SPARA DESSA ANVISNINGAR

Figyelem  FONTOS BIZTONSÁGI ELOÍRÁSOK

Ez a figyelmezeto jel veszélyre utal. Sérülésveszélyt rejtó helyzetben van. Mielőtt bármi berendezésen munkát végezte, legyen figyelemmel az elektromos áramkörök okozta kockázatokra, és ismerkedjen meg a szokásos balesetvédelmi eljárásokkal. A kiadványban szereplő figyelmeztetések fordítása a készülékhöz mellékelő biztonsági figyelmeztetések között található; a fordítás az egyes figyelmeztetések végén látható szám alapján keresheto meg.

ORIZZE MEG EZEKET AZ UTASÍTÁSOKAT!

Предупреждение ВАЖНЫЕ ИНСТРУКЦИИ ПО СОБЛЮДЕНИЮ ТЕХНИКИ БЕЗОПАСНОСТИ

Этот символ предупреждения обозначает опасность. То есть имеет место ситуация, в которой следует опасаться телесных повреждений. Перед эксплуатацией оборудования выясните, каким опасностям может подвергаться пользователь при использовании электрических цепей, и ознакомьтесь с правилами техники безопасности для предотвращения возможных несчастных случаев. Воспользуйтесь номером заявления, приведённым в конце каждого предупреждения, чтобы найти его переведенный вариант в переводе предупреждений по безопасности, прилагаемом к данному устройству.

СОХРАНИТЕ ЭТИ ИНСТРУКЦИИ
Related Documentation

For instructions on installing and configuring Cisco 7600 series routers, refer to these publications:

- Regulatory Compliance and Safety Information for the Cisco 7600 Series Routers
- Cisco 7609 Router Installation Guide
- Cisco 7600 Series Router Module Installation Guide
- Cisco 7600 Series Router Quick Software Configuration Guide
-Cisco 7600 Series Router Software Configuration Guide
- Cisco 7600 Series Router IOS Command Reference
- Cisco 7600 Series Router IOS System Message Guide
- Cisco 7600 Series Router IOS Software Configuration Guide
- Cisco 7600 Series Router IOS Command Reference
- Cisco 7600 Series Router IOS System Message Guide
- Installation Note for the CWDM Passive Optical System
- Cisco 7600 Series Router SIP, SSC, and SPA Hardware Installation Guide
- Cisco 7600 Series Router SIP, SSC, and SPA Software Configuration Guide

For information about MIBs, refer to the following World Wide Web site:
Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly What’s New in Cisco Product Documentation, which also lists all new and revised Cisco technical documentation, at:


Subscribe to the What’s New in Cisco Product Documentation as an RSS feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service. Cisco currently supports RSS Version 2.0.
Modules Overview

This chapter provides important information about the Cisco 7600 series routers modules. This chapter contains these sections:

- LEDs, page 1-1
- Port Addresses, page 1-2
- Hot Swapping Modules, page 1-4
- Power Management and Environmental Monitoring, page 1-4
- Limiting Connection Distances, page 1-4
- Port Densities, page 1-6
- Gigabit Interface Converters, page 1-7
- Software Requirements, page 1-13

This book does not contain instructions for installing the router chassis or for installing modules in the router chassis. For information on installing the router chassis, refer to the Cisco 7600 Series Router Installation Guide. For information on installing modules in a router chassis, refer to the Cisco 7600 Series Router Module Installation Guide.

LEDs

The LEDs on the router module front panel indicate the status of the module. Table 1-1 lists the LEDs and their function.

<table>
<thead>
<tr>
<th>LED</th>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>Green</td>
<td>All diagnostics pass. The module is operational (normal initialization sequence).</td>
</tr>
<tr>
<td></td>
<td>Orange</td>
<td>The module is booting or running diagnostics (normal initialization sequence). Make sure the module is fully seated in its slot and that the ejector levers are completely closed. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.)</td>
</tr>
</tbody>
</table>
Each port (or interface) in the router is designated by several different types of addresses. The physical interface address is the actual physical location (slot and port) of the interface connector within the chassis. The system software uses the physical addresses to control activity within the router and to display status information. These physical slot and port addresses are not used by other devices in the network; they are specific to the individual router and its internal components and software. For more information, see the “Physical Interface Addresses” section on page 1-2.

<table>
<thead>
<tr>
<th>LED</th>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td></td>
<td>The diagnostic test failed. The module is not operational because a fault occurred during the initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.)</td>
</tr>
<tr>
<td>LINK</td>
<td>Green</td>
<td>The port is operational.</td>
</tr>
<tr>
<td>Orange</td>
<td>The link has been disabled by software.</td>
<td></td>
</tr>
<tr>
<td>Flashing orange</td>
<td>The link is bad and has been disabled due to a hardware failure.</td>
<td></td>
</tr>
<tr>
<td>Off</td>
<td>No signal is detected.</td>
<td></td>
</tr>
</tbody>
</table>

**Note**

For Cisco 7600 series routers running Cisco IOS software, refer to the appropriate *Cisco 7600 Series Cisco IOS Software Configuration Guide*, for port address information.

The Media Access Control (MAC) address is a standardized data link layer address that is required for every port or device that connects to a network. Other devices in the network use these addresses to locate specific ports in the network; they are specific to the individual router and its internal components and software. The routers use a unique method, described in the “MAC Addresses” section on page 1-3, to assign and control the MAC addresses of their interfaces.

**Physical Interface Addresses**

Physical port addresses specify the actual physical location of each module port on the rear of the router, as shown in Figure 1-1. (The port numbering convention is the same in the 6-slot, 9-slot, and 13-slot chassis.) The address is a two-part number in the format *slot/port number*. The first number identifies the slot in which the module is installed. Module slots are numbered from top to bottom starting with 1. The second number identifies the physical port number on the module. The port numbers always begin at 1 and are numbered from left to right. The number of additional ports (n/1, n/2, and so on) depends on the number of ports on the module.
Interface ports maintain the same addresses regardless of whether other modules are installed or removed. However, when you move a module to a different slot, the first number in the address changes to reflect the new slot number. For example, on a 48-port 10/100BASE-T module in slot 2, the address of the left port is 2/1 and the address of the right port is 2/48. If you remove the 48-port 10/100BASE-T module from slot 2 and install it in slot 4, the addresses of those same ports become 4/1 through 4/48.

The supervisor engine is n/1 to n/2 because it supports two interfaces: ports 1 and 2. Router modules are addressed n/1 through n/N.

You can identify each module port by checking its slot and port location on the router. You can also use software commands to display information about a specific interface, or all interfaces, in the router. To display information about every interface, enter the `show port` command without parameters. To display information about a specific interface, enter the `show port` command with the module (slot) number and port number in the format `show port [mod_num/port_num]`.

**MAC Addresses**

All network interface connections (ports) require a unique MAC address. The MAC address of an interface is stored in electrically erasable programmable read-only memory (EEPROM) on a component that resides directly on the interface circuitry. The router system code reads the EEPROM for each
interface in the system, learns the MAC addresses, and then initializes appropriate hardware and data structures. Each VLAN in the spanning tree has one unique MAC address. This addressing scheme gives the router the intelligence to identify the state (connected or not connected) of each interface. When you hot swap a module, the MAC address changes with the module.

**Hot Swapping Modules**

You can remove and replace modules without powering down the router. This feature is known as *hot swapping*.

When you remove or insert a module while the router is powered on and operating, the router does the following:

1. Determines if there is sufficient power for the module.
2. Scans the backplane for configuration changes.
3. Initializes all newly inserted modules, notes any removed modules, and places them in the administratively shutdown state.
4. Places any previously configured interfaces on the module back to the state they were in when they were removed. Any newly inserted interfaces are put in the administratively shutdown state, as if they were present (but unconfigured) at boot time. If you insert a similar module type into a slot, its ports are configured and brought online up to the port count of the original module.

The router runs diagnostic tests on any new interfaces. If the test passes, the router is operating normally. If the new module is faulty, the router resumes normal operation but leaves the new interface disabled. If the diagnostic test fails, the router crashes, which usually indicates that the new module has a problem in the bus and should be removed.

---

**Caution**

To avoid erroneous failure messages, note the current configuration of all interfaces before you remove or replace another module, and allow at least 15 seconds for the system to reinitialize after a module has been removed or replaced.

For router module removal and installation procedures, refer to the *Cisco 7600 Series Router Module Installation Guide*.

**Power Management and Environmental Monitoring**

For detailed information on power management and environmental monitoring, refer to the appropriate *Cisco 7600 Series Cisco IOS Software Configuration Guide* for your software release.

**Limiting Connection Distances**

The length of your networks and the distances between connections depend on the type of signal, the signal speed, and the transmission media (the type of cabling used to transmit the signals). For example, fiber-optic cable has a greater channel capacity than twisted-pair cabling. The distance and rate limits in this chapter are the IEEE-recommended maximum speeds and distances for signaling. However, if you understand the electrical problems that may arise and can compensate for them, you should get good results with rates and distances greater than those described here, although you do so at your own risk.
Port Connector Requirements

You need these connector types to cable to the module ports:

- SC connectors for GBICs. (See Figure 1-2.)

  **Note** When you plug the SC connector into the GBIC, make sure that both the Tx and Rx fiber-optic cables are fully inserted into the SC connector.

  **Note** If you are using the LX/LH GBIC with MMF, you need to install a patch cord between the GBIC and the MMF cable. Refer to the “Patch Cord” section of the Cisco 7600 Series Router Module Installation Guide for details.

- RJ-45 male connectors for the 48-port 10/100BASE-T RJ-45 module. (See Figure 1-3.)
- MT-RJ fiber-optic connectors for the 24-port 100BASE-FX module. (See Figure 1-4.)
- LC connectors for the SFP optical tranceivers installed in the Supervisor Engine 720. (See Figure 1-5.)
- RJ-21 telco connectors for the 48-port 10/100BASE-T R J-21 telco module. (See Figure 1-6.)

**Figure 1-2 SC Fiber-Optic Cable Connector**

**Figure 1-3 RJ-45 Interface Cable Connector**
Figure 1-4  MT-RJ Fiber-Optic Cable Connector

Figure 1-5  LC Fiber-Optic Connector

Figure 1-6  RJ-21 Telco Interface Cable Connectors

Port Densities

Table 1-2 lists the bandwidth and port densities of the c7600 series routers.
Chapter 1      Modules Overview

Gigabit Interface Converters

A Gigabit Interface Converter (GBIC) is a hot-swappable input/output device that plugs into a supervisor engine or Gigabit Ethernet module which links the module with the fiber-optic network or with the copper network.

This section contains these topics:

- **WS-G5483 Copper GBIC, page 1-8**
- **WS-G5484, WS-G5486, and WS-G5487 Optical GBICs, page 1-9**
- **Coarse Wave Division Multiplexing GBICs, page 1-9**

### Table 1-2  Cisco 7600 Series Router Bandwidth and Port Density

<table>
<thead>
<tr>
<th>Architecture</th>
<th>Cisco 7603 Router</th>
<th>Cisco 7604 Router</th>
<th>Cisco 7606 Router</th>
<th>Cisco 7609 Router</th>
<th>Cisco 7609-S Router</th>
<th>Cisco 7613 Router</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backplane Bandwidth for Supervisor Engine 32</td>
<td>32 Gbps</td>
<td>32 Gbps</td>
<td>32 Gbps</td>
<td>32 Gbps</td>
<td>32 Gbps</td>
<td>32 Gbps</td>
</tr>
<tr>
<td>Backplane Bandwidth for Supervisor Engine 720</td>
<td>720 Gbps</td>
<td>720 Gbps</td>
<td>720 Gbps</td>
<td>720 Gbps</td>
<td>720 Gbps</td>
<td>720 Gbps</td>
</tr>
<tr>
<td>Backplane Bandwidth for Supervisor Engine RSP720</td>
<td>720 Gbps</td>
<td>720 Gbps</td>
<td>720 Gbps</td>
<td>720 Gbps</td>
<td>720 Gbps</td>
<td>720 Gbps</td>
</tr>
<tr>
<td>Number of Gigabit Ethernet ports</td>
<td>34</td>
<td>50</td>
<td>82</td>
<td>130</td>
<td>130</td>
<td>194</td>
</tr>
<tr>
<td>Number of OC-3 POS ports</td>
<td>32</td>
<td>48</td>
<td>80</td>
<td>128</td>
<td>128</td>
<td>192</td>
</tr>
<tr>
<td>Number of OC-12 POS ports</td>
<td>8</td>
<td>12</td>
<td>20</td>
<td>32</td>
<td>32</td>
<td>48</td>
</tr>
<tr>
<td>Number of OC-48 POS ports</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Number of OC-12 ATM ports</td>
<td>4</td>
<td>6</td>
<td>10</td>
<td>16</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>Number of channelized OC-12 ports</td>
<td>8</td>
<td>12</td>
<td>20</td>
<td>32</td>
<td>32</td>
<td>48</td>
</tr>
<tr>
<td>Number of FlexWAN modules</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>
WS-G5483 Copper GBIC

The WS-G5483 GBIC uses Category 5, Category 5e, or Category 6 UTP/FTP cable to provide 1000BASE-T full-duplex connectivity between the Gigabit Ethernet module or supervisor engine and the network up to a distance of 328 feet (100 meters). (See Figure 1-7.) Refer to your release notes or the online 1000BASE-T GBIC Switch Compatibility Matrix posted with the GBIC documentation on Cisco.com for the list of modules and the required software release level necessary to support this GBIC.

Caution

To comply with GR-1089 intrabuilding, lightening-immunity requirements, you must use foil-twisted pair (FTP) cable that is properly grounded at both ends.

Figure 1-7 Copper GBIC (WS-G5483)
WS-G5484, WS-G5486, and WS-G5487 Optical GBICs

Table 1-3 lists the three types of optical GBICs.

**Table 1-3 Optical GBIC Model List**

<table>
<thead>
<tr>
<th>Product Number</th>
<th>GBIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS-G5484</td>
<td>Short wavelength (1000BASE-SX)</td>
</tr>
<tr>
<td>WS-G5486</td>
<td>Long wavelength/long haul (1000BASE-LX/LH)</td>
</tr>
<tr>
<td>WS-G5487</td>
<td>Extended distance (1000BASE-ZX)</td>
</tr>
</tbody>
</table>

Each of the three types of optical GBICs comes in two physical models shown in Figure 1-8. These two physical models require different installation procedures.

**Figure 1-8 Optical GBIC Physical Styles (WS-G5484, WS-G5486, and WS-G5487)**

Coarse Wave Division Multiplexing GBICs

Eight GBICs are available for use with the CWDM Passive Optical System. (See Figure 1-9.) Table 1-4 lists the available GBICs. These eight GBICs are installed in the Cisco 7600 series routers modules that support GBICs and are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the *Installation Note for the Cisco CWDM Passive Optical System*.

**Figure 1-9 CWDM GBIC**
Chapter 1      Modules Overview

Gigabit Interface Converters

SFP Optical Transceivers

Small Form-Factor Pluggable (SFP) optical transceiver modules are hot-pluggable and field-replaceable, and you can insert them into SFP module slots on the front panel of the Supervisor Engine 720 and the WS-X6724-SFP Gigabit Ethernet module. The SFP optical transceiver modules use an LC connector.

You can use any combination of SFP modules that your Cisco device supports. The only restrictions are that each SFP port must match the wavelength specifications on the other end of the cable and that the cable must not exceed the stipulated cable length for reliable communications.

Table 1-4  CWDM GBICs

<table>
<thead>
<tr>
<th>Model Number</th>
<th>CWDM GBIC Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWDM-GBIC-1470=</td>
<td>1470 nm laser, single mode</td>
</tr>
<tr>
<td>CWDM-GBIC-1490=</td>
<td>1490 nm laser, single mode</td>
</tr>
<tr>
<td>CWDM-GBIC-1510=</td>
<td>1510 nm laser, single mode</td>
</tr>
<tr>
<td>CWDM-GBIC-1530=</td>
<td>1530 nm laser, single mode</td>
</tr>
<tr>
<td>CWDM-GBIC-1550=</td>
<td>1550 nm laser, single mode</td>
</tr>
<tr>
<td>CWDM-GBIC-1570=</td>
<td>1570 nm laser, single mode</td>
</tr>
<tr>
<td>CWDM-GBIC-1590=</td>
<td>1590 nm laser, single mode</td>
</tr>
<tr>
<td>CWDM-GBIC-1610=</td>
<td>1610 nm laser, single mode</td>
</tr>
</tbody>
</table>

SFP Optical Transceiver Module

Figure 1-10  SFP Optical Transceiver Module
Chapter 1 Modules Overview

Gigabit Interface Converters

Table 1-5 SFP Optical Transceiver Module Cabling Specifications

<table>
<thead>
<tr>
<th>SFP Module</th>
<th>Wavelength (nanometers)</th>
<th>Fiber Type</th>
<th>Core Size (micron)</th>
<th>Modal Bandwidth (MHz/km)</th>
<th>Cable Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000BASE-SX (GLC-SX-MM)</td>
<td>850</td>
<td>MMF</td>
<td>62.5</td>
<td>160</td>
<td>722 feet (220 m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>62.5</td>
<td>200</td>
<td>902 feet (275 m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50.0</td>
<td>400</td>
<td>1640 feet (500 m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50.0</td>
<td>500</td>
<td>1804 feet (550 m)</td>
</tr>
<tr>
<td>1000BASE-LX/LH (GLC-LH-SM)</td>
<td>1300</td>
<td>MMF(^1)</td>
<td>62.5</td>
<td>500</td>
<td>1804 feet (550 m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SMF</td>
<td>50.0</td>
<td>400</td>
<td>1804 feet (550 m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50.0</td>
<td>500</td>
<td>1804 feet (550 m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9/10</td>
<td>—</td>
<td>32,810 feet (10 km)</td>
</tr>
<tr>
<td>1000BASE-ZX (GLC-ZX-SM)</td>
<td>1550</td>
<td>SMF</td>
<td>9/10</td>
<td>—</td>
<td>43.4 to 62 miles (70 to 100 km)(^2)</td>
</tr>
</tbody>
</table>

1. A mode-conditioning patch cord is required. Using an ordinary patch cord with MMF, 1000BASE-LX/LH SFP modules, and a short link distance can cause transceiver saturation, resulting in an elevated bit error rate (BER). When using the LX/LH SFP module with 62.5-micron diameter MMF, you must also install a mode-conditioning patch cord between the SFP module and the MMF cable on both the sending and receiving ends of the link. The mode-conditioning patch cord is required for link distances greater than 984 feet (300 m).

2. 1000BASE-ZX SFP modules can reach up to 100 km by using dispersion-shifted SMF or low-attenuation SMF; the distance depends on the fiber quality, the number of splices, and the connectors.

1000BASE-T SFP Transceiver Modules

The 1000BASE-T SFP transceiver modules provide Category 5, Category 5e, and Category 6 support for SFP modules. The 1000BASE-T SFP transceiver modules use standard four twisted-pair cable at lengths up to 328 feet (100 meters) and have standard RJ-45 connectors. Figure 1-11 shows a 1000BASE-T SFP module.

Figure 1-11 1000BASE-T SFP Transceiver Module

CWDM SFP Optical Transceiver Modules

The Coarse Wavelength Division Multiplexing (CWDM) SFP optical transceiver modules are hot-swappable, and can be plugged into standard receptacles in switching modules that convert Gigabit Ethernet electrical signals into a single-mode fiber-optic (SMF) interface. You can connect the CWDM SFPs to CWDM passive optical system optical add/drop multiplexer (OADM) modules or multiplexer/demultiplexer plug-in modules using single-mode fiber-optic cables with standard SC connectors. Table 1-6 lists the available CWDM SFP wavelengths and color-coding identifier.
### XenPak Optical Transceiver Modules

The XenPak optical transceiver modules are hot-swappable, transceiver components that you can plug into standard receptacles in modules that convert Gigabit Ethernet electrical signals into a single-mode fiber-optic (SMF) interface. *Figure 1-13* shows a XenPak optical transceiver module.
**Figure 1-13 XenPak Optical Transceiver Module**

![XenPak Optical Transceiver Module Diagram]

Table 1-7 lists the available XenPak transceiver modules and their specifications.

<table>
<thead>
<tr>
<th>XenPak</th>
<th>Wavelength</th>
<th>Connector and Cable Type</th>
<th>Maximum Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>XENPAK-10GB-LR</td>
<td>1310 nm</td>
<td>SC; SMF</td>
<td>6.2 miles (10 km)</td>
</tr>
<tr>
<td>XENPAK-10GB-ER</td>
<td>1550 nm</td>
<td>SC; SMF</td>
<td>24.85 miles (40 km)</td>
</tr>
</tbody>
</table>

**Software Requirements**

For information on the minimum, recommended, and default software versions for the Cisco 7600 series routers, supervisor engines, and modules, refer to the applicable release notes for the latest maintenance release of your software.
Ethernet and Gigabit Ethernet Switching Modules

This chapter describes the Ethernet and Gigabit Ethernet switching modules, and it contains these sections:

- 10/100 and 10/100/1000 Ethernet Switching Modules, page 2-15
- Gigabit Ethernet Switching Modules, page 2-27
- Ethernet Module LEDs, page 2-35

10/100 and 10/100/1000 Ethernet Switching Modules

Note
Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes for the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

This section describes these 10/100 and 10/100/1000 Ethernet switching modules:

- 24-Port 10BASE-FL Ethernet Switching Module (WS-X6024-10FL-MT), page 2-18
- 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148-GE-TX), page 2-18
- 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148V-GE-TX), page 2-18
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ21V), page 2-19
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ45V), page 2-20
- 24-Port 100BASE-FX Ethernet Switching Module (WS-X6224-100FX-MT), page 2-20
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-RJ45), page 2-21
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-TEL), page 2-21
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248A-TEL), page 2-21
- 24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-MM), page 2-22
- 24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-SM), page 2-22
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ21V), page 2-23
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ45), page 2-23
- 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ45V), page 2-24
- 24-Port 100BASE-FX Fabric-Enabled Ethernet Switching Module (WS-X6524-100FX-MM), page 2-24
- 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548-GE-TX), page 2-25
- 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548V-GE-TX), page 2-25
- 48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-21), page 2-26
- 48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-45), page 2-26
- 48-Port 10/100/1000BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6748-GE-TX), page 2-27

Table 2-1 lists the features of the Ethernet switching modules.

<table>
<thead>
<tr>
<th>Product Number</th>
<th>Backplane Connection</th>
<th>Forwarding</th>
<th>Inline Power(^1)</th>
<th>Port Buffer Size</th>
<th>Queues Per Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS-X6024-10FL-MT</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>No</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-X6148-GE-TX</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>Optional(^2)</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-6148V-GE-TX</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>Yes</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-X6148-RJ21V</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>Yes</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-X6148-RJ45V</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>Yes</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-X6224-100FX-MT</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>Yes</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-X6248-RJ-45</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>No</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-X6248-TEL</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>No</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-X6248A-TEL</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>No</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-X6324-100FX-MM</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>No</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-X6324-100FX-SM</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>No</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-X6348-RJ21V</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>Yes</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-X6348-RJ45V</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>Optional(^2)</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
<tr>
<td>WS-X6348-RJ45V</td>
<td>32 Gbps Bus</td>
<td>Centralized</td>
<td>Yes</td>
<td>128 KB</td>
<td>2 transmit, 1 receive</td>
</tr>
</tbody>
</table>
### Table 2-1 Ethernet Switching Modules Features (continued)

<table>
<thead>
<tr>
<th>Product Number</th>
<th>Backplane Connection</th>
<th>Forwarding</th>
<th>Inline Power(^1)</th>
<th>Port Buffer Size</th>
<th>Queues Per Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS-X6524-100FX-MM</td>
<td>Switch Fabric and Bus</td>
<td>Centralized</td>
<td>No</td>
<td>1 MB</td>
<td>4 transmit, 2 receive</td>
</tr>
<tr>
<td>WS-X6548-GE-TX</td>
<td>Switch Fabric and Bus</td>
<td>Centralized</td>
<td>Optional(^2)</td>
<td>1 MB</td>
<td>4 transmit, 2 receive</td>
</tr>
<tr>
<td>WS-6548V-GE-TX</td>
<td>Switch Fabric and Bus</td>
<td>Centralized</td>
<td>Yes</td>
<td>1 MB</td>
<td>4 transmit, 2 receive</td>
</tr>
<tr>
<td>WS-X6548-RJ-21</td>
<td>Switch Fabric and Bus</td>
<td>Centralized</td>
<td>No</td>
<td>1 MB</td>
<td>4 transmit, 2 receive</td>
</tr>
<tr>
<td>WS-X6548-RJ-45</td>
<td>Switch Fabric and Bus</td>
<td>Centralized</td>
<td>No</td>
<td>1 MB</td>
<td>4 transmit, 2 receive</td>
</tr>
<tr>
<td>WS-X6748-GE-TX</td>
<td>Switch Fabric</td>
<td>CEF720</td>
<td>No</td>
<td>1.3 MB</td>
<td>4 transmit, 2 receive</td>
</tr>
</tbody>
</table>

1. Supports IP phones.
2. Supports an optional inline power field upgrade module (WS-F6K-VPWR=)
24-Port 10BASE-FL Ethernet Switching Module (WS-X6024-10FL-MT)

The 24-port 10BASE-FL switching module (WS-X6024-10FL-MT) provides 24 switched, 10-Mbps, full- or half-duplex ports. (See Figure 2-1.) The module has 24 MT-RJ connectors for connection to multimode fiber-optic (MMF) cable.

The QoS port architecture (Rx/Tx) for this module is 1q4t/2q2t.

Note

This module is a Class 1 laser product. Refer to the Regulatory Compliance and Safety Information for the Cisco 7600 Series Routers for information on working with lasers.

Figure 2-1 24-Port 10BASE-FL Ethernet Switching Module (WS-X6024-10FL-MT)

The front panel LEDs are described in Table 2-3 on page 2-35.

48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148-GE-TX)

The 48-port 10/100/1000BASE-T switching module (WS-X6148-GE-TX) provides 48 switched, 10/100/1000-Mbps autosensing, full- or half-duplex ports. (See Figure 2-2.) The module has 48 RJ-45 connectors for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. This module can be upgraded with an inline-power daughter card to support IP phones.

Figure 2-2 48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148-GE-TX)

The front panel LEDs are described in Table 2-3 on page 2-35.

48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6148V-GE-TX)

The 48-port 10/100/1000BASE-T switching module (WS-X6148V-GE-TX) provides 48 switched, 10/100/1000-Mbps autosensing, full- or half-duplex ports. (See Figure 2-3.) The module has 48 RJ-45 connectors for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. The “V” in the product number indicates that the inline-power daughter card is installed on the module. With the voice daughter card installed, the module provides these IP phone features on each port:

- Inline power—Provides 48 VDC over standard Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters) from the switch to the IP phone. With inline power, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in the cable are used to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called phantom power because the power signals travel over the same two pairs used to transmit Ethernet signals. The power signals are completely transparent to the Ethernet signals and do not interfere with their operation.
Phone discovery—Automatically detects the presence of an IP phone and supplies inline power to the phone.

Auxiliary VLANs—Provides automatic VLAN configuration for IP phones using IEEE 802.1Q as the standards-based VLAN tagging mechanism between the switch and the IP phone.

The QoS port architecture (Rx/Tx) for this module is 1q4t/2q2t.

The front panel LEDs are described in Table 2-3 on page 2-35.

### 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ21V)

The 48-port 10/100BASE-T switching module (WS-X6148-RJ21V) provides 48 switched, 10/100-Mbps autosensing, full- or half-duplex ports. (See Figure 2-4.) The module has 4 RJ-21 connectors (12 ports per connector) for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. The “V” in the product number indicates that the inline-power daughter card (WS-F6K-VPWR) is installed on the module. With the WS-F6K-VPWR daughter card installed, the module provides these IP phone features on each port:

- **Inline power**—Provides 48 VDC over standard Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters) from the switch to the IP phone. With inline power, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in the cable are used to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called *phantom power* because the power signals travel over the same two pairs used to transmit Ethernet signals. The power signals are completely transparent to the Ethernet signals and do not interfere with their operation.

- **Phone discovery**—Automatically detects the presence of an IP phone and supplies inline power to the phone.

- **Auxiliary VLANs**—Provides automatic VLAN configuration for IP phones using IEEE 802.1Q as the standards-based VLAN tagging mechanism between the switch and the IP phone.

The QoS port architecture (Rx/Tx) for this module is 1q4t/2q2t.

The front panel LEDs are described in Table 2-3 on page 2-35.
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ45V)

The 48-port 10/100BASE-T switching module (WS-X6148-RJ45V) provides 48 switched, 10/100-Mbps autosensing, full- or half-duplex ports. (See Figure 2-5.) The module has 48 RJ-45 connectors for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. The “V” in the product number indicates that the inline-power daughter card (WS-F6K-VPWR) is installed on the module. With the WS-F6K-VPWR daughter card installed, the module provides these IP phone features on each port:

- **Inline power**—Provides 48 VDC over standard Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters) from the switch to the IP phone. With inline power, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in the cable are used to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called *phantom power* because the power signals travel over the same two pairs used to transmit Ethernet signals. The power signals are completely transparent to the Ethernet signals and do not interfere with their operation.
- **Phone discovery**—Automatically detects the presence of an IP phone and supplies inline power to the phone.
- **Auxiliary VLANs**—Provides automatic VLAN configuration for IP phones using IEEE 802.1Q as the standards-based VLAN tagging mechanism between the switch and the IP phone.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

![Figure 2-5 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6148-RJ45V)]

The front panel LEDs are described in Table 2-3 on page 2-35.

24-Port 100BASE-FX Ethernet Switching Module (WS-X6224-100FX-MT)

The 24-port 100BASE-FX Etherent switching module (WS-X6224-100FX-MT) provides 24 switched, 100-Mbps, full or half-duplex ports. (See Figure 2-6.) Ports have MT-RJ optical connectors for connection to MMF optical cable.

*Note* This module is a Class I laser product. Refer to the Regulatory Compliance and Safety Information for the Cisco 7600 Series Routers for information on working with lasers.

The QoS port architecture (Rx/Tx) for this module is **1q4t/2q2t**.

![Figure 2-6 24-Port 100BASE-FX Ethernet Switching Module (WS-X6224-100FX-MT)]

The front panel LEDs are described in Table 2-3 on page 2-35.
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-RJ45)

The 48-port 10/100BASE-T Ethernet switching module (WS-X6248-RJ45) provides 48 switched 10/100-Mbps autosensing, full or half-duplex ports. (See Figure 2-7.) The 48 ports have RJ-45 connectors for Category 3, Category 5, Category 5e, or Category 6 UTP or FTP cable.

The QoS port architecture (Rx/Tx) for this module is 1q4t/2q2t.

*Figure 2-7  48-Port 10/100BASE-TX Ethernet Switching Module (WS-X6248-RJ45)*

The front panel LEDs are described in Table 2-3 on page 2-35.

48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-TEL)

The 48-port 10/100BASE-T Ethernet switching module (WS-X6248-TEL) provides 48 switched 10/100-Mbps autosensing, full or half-duplex ports. (See Figure 2-8.) Four RJ-21 connectors (12 ports per connector) use Category 3, Category 5, Category 5e, or Category 6 UTP or FTP cable to connect to the network.

The QoS port architecture (Rx/Tx) for this module is 1q4t/2q2t.

*Figure 2-8  48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248-TEL)*

The front panel LEDs are described in Table 2-3 on page 2-35.

48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248A-TEL)

The 48-port 10/100BASE-T Ethernet switching module (WS-X6248A-TEL) provides 48 switched 10/100-Mbps autosensing, full or half-duplex ports. (See Figure 2-9.) The WS-X6248A-TEL Ethernet module has a larger buffer than the WS-X6248-TEL Ethernet module. Four RJ-21 connectors (12 ports per connector) use Category 3, Category 5, Category 5e, or Category 6 UTP or FTP cable to connect to the network.

The QoS port architecture (Rx/Tx) for this module is 1q4t/2q2t.

*Figure 2-9  48-Port 10/100BASE-T Ethernet Switching Module (WS-X6248A-TEL)*

The front panel LEDs are described in Table 2-3 on page 2-35.
24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-MM)

The 24-port 100BASE-FX switching module (WS-X6324-100FX-MM) provides 24 switched, 100-Mbps, full- or half-duplex ports. (See Figure 2-10.) The module has 24 MT-RJ connectors for connection to the MMF cable.

**Note**

This module is a Class 1 laser product. Refer to the *Regulatory Compliance and Safety Information for the Cisco 7600 Series Routers* for information on working with lasers.

The QoS port architecture (Rx/Tx) for this module is 1q4t/2q2t.

**Figure 2-10** 24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-MM)

The front panel LEDs are described in Table 2-3 on page 2-35.

24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-SM)

The 24-port 100BASE-FX switching module (WS-X6324-100FX-SM) provides 24 switched, 100-Mbps, full- or half-duplex ports. (See Figure 2-11.) The module has 24 MT-RJ connectors for connection to SMF cable.

**Note**

This module is a Class 1 laser product. Refer to the *Regulatory Compliance and Safety Information for the Cisco 7600 Series Routers* for information on working with lasers.

The QoS port architecture (Rx/Tx) for this module is 1q4t/2q2t.

**Figure 2-11** 24-Port 100BASE-FX Ethernet Switching Module (WS-X6324-100FX-SM)

The front panel LEDs are described in Table 2-3 on page 2-35.
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ21V)

The 48-port 10/100BASE-T switching module (WS-X6148-RJ21V) provides 48 switched, 10/100-Mbps autosensing, full- or half-duplex ports. (See Figure 2-12.) The module has 4 RJ-21 connectors (12 ports per connector) for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. The “V” in the product number indicates that the inline-power daughter card (WS-F6K-VPWR) is installed on the module. With the WS-F6K-VPWR daughter card installed, the module provides these IP phone features on each port:

- **Inline power**—Provides 48 VDC over standard Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters) from the switch to the IP phone. With inline power, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in the cable are used to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called *phantom power* because the power signals travel over the same two pairs used to transmit Ethernet signals. The power signals are completely transparent to the Ethernet signals and do not interfere with their operation.

- **Phone discovery**—Automatically detects the presence of an IP phone and supplies inline power to the phone.

- **Auxiliary VLANs**—Provides automatic VLAN configuration for IP phones using IEEE 802.1Q as the standards-based VLAN tagging mechanism between the switch and the IP phone.

The QoS port architecture (Rx/Tx) for this module is 1q/4t/2q2t.

*Figure 2-12  48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ21V)*

The front panel LEDs are described in Table 2-3 on page 2-35.

48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ-45)

The 48-port 10/100BASE-T switching module (WS-X6348-RJ-45) provides 48 switched, 10/100-Mbps autosensing, full- or half-duplex ports. (See Figure 2-13.) The module has 48 RJ-45 connectors for connection to either Category 3, Category 5, Category 5e, or Category 6 UTP or FTP cable. This module can be upgraded with an inline-power daughter card to support IP phones.

The QoS port architecture (Rx/Tx) for this module is 1q/4t/2q2t.

*Figure 2-13  48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ-45)*

The front panel LEDs are described in Table 2-3 on page 2-35.
48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ45V)

The 48-port 10/100BASE-T switching module (WS-X6348-RJ45V) provides 48 switched, 10/100-Mbps autosensing, full- or half-duplex ports. (See Figure 2-14.) The module has 48 RJ-45 connectors for use with either Category 3, Category 5, Category 5e, or Category 6 UTP or FTP cable. The “V” in the product number indicates that the inline-power daughter card (WS-F6K-VPWR) is installed on the module. With the WS-F6K-VPWR daughter card installed, the module provides these IP phone features on each port:

- **Inline power**—Provides 48 VDC over standard Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters) from the switch to the IP phone. With inline power, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in the cable are used to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called *phantom power* because the power signals travel over the same two pairs used to transmit Ethernet signals. The power signals are completely transparent to the Ethernet signals and do not interfere with their operation.
- **Phone discovery**—Automatically detects the presence of an IP phone and supplies inline power to the phone.
- **Auxiliary VLANs**—Provides automatic VLAN configuration for IP phones using IEEE 802.1Q as the standards-based VLAN tagging mechanism between the switch and the IP phone.

The QoS port architecture (Rx/Tx) for this module is 1q4t/2q2t.

![Figure 2-14 48-Port 10/100BASE-T Ethernet Switching Module (WS-X6348-RJ45V)](image)

The front panel LEDs are described in Table 2-3 on page 2-35.

24-Port 100BASE-FX Fabric-Enabled Ethernet Switching Module (WS-X6524-100FX-MM)

The 24-port 100BASE-FX switching module (WS-X6524-100FX-MM) provides 24 switched, 100-Mbps, full- or half-duplex ports. (See Figure 2-15.) Ports have MT-RJ connectors for MMF cable. The WS-X6524-100FX-MM module has 1-MB per-port packet buffers and a single fabric channel interface. The switching module is upgradable to support distributed forwarding with an optional Distributed Forwarding Card (WS-F6K-DFC).

**Note**

This module is a Class 1 laser product. Refer to the *Regulatory Compliance and Safety Information for the Cisco 7600 Series Routers* for information on working with lasers.

The QoS port architecture (Rx/Tx) for this module is 1p1q0t/1p3q1t.
Figure 2-15  24-Port 100BASE-FX Fabric-Enabled Ethernet Switching Module (WS-X6524-100FX-MM)

The front panel LEDs are described in Table 2-3 on page 2-35.

48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548-GE-TX)

The 48-port 10/100/1000BASE-T switching module (WS-X6548-GE-TX) provides 48 switched, 10/100/1000-Mbps autosensing, full- or half-duplex ports. (See Figure 2-16.) The module has 48 RJ-45 connectors for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. This module can be upgraded with an inline-power daughter card to support IP phones.

Figure 2-16  48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548-GE-TX)

The front panel LEDs are described in Table 2-3 on page 2-35.

48-Port 10/100/1000BASE-T Ethernet Switching Module (WS-X6548V-GE-TX)

The 48-port 10/100/1000BASE-T switching module (WS-X6548V-GE-TX) provides 48 switched, 10/100/1000-Mbps autosensing, full- or half-duplex ports. (See Figure 2-17.) The module has 48 RJ-45 connectors for use with either Category 3, Category 5, Category 5e, or Category 6 UTP cable. The “V” in the product number indicates that the inline-power daughter card is installed on the module. With the voice daughter card installed, the module provides these IP phone features on each port:

- Inline power—Provides 48 VDC over standard Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters) from the switch to the IP phone. With inline power, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in the cable are used to transmit power (6.3 W) from the switch. This method of supplying power is sometimes called phantom power because the power signals travel over the same two pairs used to transmit Ethernet signals. The power signals are completely transparent to the Ethernet signals and do not interfere with their operation.
- Phone discovery—Automatically detects the presence of an IP phone and supplies inline power to the phone.
- Auxiliary VLANs—Provides automatic VLAN configuration for IP phones using IEEE 802.1Q as the standards-based VLAN tagging mechanism between the switch and the IP phone.

The QoS port architecture (Rx/Tx) for this module is 1q4t/2q2t.
48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-21)

The 48-port 10/100BASE-T switching module (WS-X6548-RJ-21) provides 48 switched, 10/100-Mbps, full- or half-duplex ports. (See Figure 2-18.) The module has 4 RJ-21 connectors (12 ports per connector) for Category 5, Category 5e, or Category 6 cable. The WS-X6548-RJ-21 module has 1-MB per-port packet buffers and a single fabric channel interface. The switching module is upgradable to support distributed forwarding with an optional Distributed Forwarding Card (WS-F6K-DFC). The WS-X6548-RJ-21 module is auto-MDI/MDIX capable; you can use either straight or crossover cable, and the module will automatically detect and adjust for the cable type.

The QoS port architecture (Rx/Tx) for this module is 1p1q0t/1p3q1t.

48-Port 10/100BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6548-RJ-45)

The 48-port 10/100BASE-T switching module (WS-X6548-RJ-45) provides 48 switched, 10/100-Mbps, full- or half-duplex ports. (See Figure 2-19.) Ports have RJ-45 connectors for Category 5, 5e, and 6 cable. The WS-X6548-RJ-45 module has 1-MB per-port packet buffers and a single fabric channel interface. The switching module is upgradable to support distributed forwarding with an optional Distributed Forwarding Card (WS-F6K-DFC). The WS-X6548-RJ-45 module is auto-MDI/MDIX capable; you can use either straight or crossover cable, and the module will automatically detect and adjust for the cable type.

The QoS port architecture (Rx/Tx) for this module is 1p1q0t/1p3q1t.
48-Port 10/100/1000BASE-T Fabric-Enabled Ethernet Switching Module (WS-X6748-GE-TX)

The 48-port 10/100/1000BASE-T switching module (WS-X6748-GE-TX) provides 48 switched, 10/100/1000-Mbps, full- or half-duplex ports. (See Figure 2-20.) Ports have RJ-45 connectors for Category 5, Category 5e, and Category 6 cable. The WS-X6748-GE-TX module has 1.3-MB per-port packet buffers and a dual-fabric channel interface. The switching module is upgradable to support distributed forwarding with an optional Distributed Forwarding Card (WS-F6K-DFC3).

The QoS port architecture (Rx/Tx) for this module is 1q8t/1p3q8t.

For LED indicators, see the “Ethernet Module LEDs” section on page 2-35.

Table 2-2 summarizes some of the features of the Gigabit Ethernet switching modules.
### Table 2-2  Gigabit and 10-Gigabit Ethernet Switching Modules Features

<table>
<thead>
<tr>
<th>Product Number</th>
<th>Backplane Connection</th>
<th>Forwarding</th>
<th>Number of Transmit Queues/Port</th>
<th>Number of Receive Queues/Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS-X6316-GE-TX</td>
<td>Bus</td>
<td>Centralized</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>WS-X6408-GBIC</td>
<td>Bus</td>
<td>Centralized</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>WS-X6408A-GBIC</td>
<td>Bus</td>
<td>Centralized</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>WS-X6416-GBIC</td>
<td>Bus</td>
<td>Centralized</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>WS-X6416-GE-MT</td>
<td>Bus</td>
<td>Centralized</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>WS-X6501-10GEX4</td>
<td>Switch fabric and bus</td>
<td>Centralized. Support for distributed forwarding with optional distributed forwarding card (DFC)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>WS-X6502-10GE</td>
<td>Switch fabric and bus</td>
<td>Centralized. Support for distributed forwarding with optional DFC</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>WS-X6516-GBIC</td>
<td>Switch fabric and bus</td>
<td>Centralized. Support for distributed forwarding with optional DFC</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>WS-X6516A-GBIC</td>
<td>Switch fabric and bus</td>
<td>Centralized. Support for distributed forwarding with optional DFC</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>WS-X6516-GE-TX</td>
<td>Switch fabric and bus</td>
<td>Centralized. Support for distributed forwarding with optional DFC</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>WS-X6704-10GE</td>
<td>Switch fabric&lt;sup&gt;1&lt;/sup&gt; (dual channel)</td>
<td>Centralized. Support for distributed forwarding with optional DFC</td>
<td>3</td>
<td>2&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>WS-X6724-SFP</td>
<td>Switch fabric</td>
<td>Centralized. Support for distributed forwarding with optional DFC</td>
<td>3</td>
<td>2&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>WS-X6748-SFP</td>
<td>Switch fabric</td>
<td>Centralized. Support for distributed forwarding with optional DFC</td>
<td>3</td>
<td>2&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>WS-X6816-GBIC</td>
<td>Switch fabric&lt;sup&gt;1&lt;/sup&gt; (dual channel)</td>
<td>Distributed forwarding with integrated DFC</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>WS-X6708-10G-3C</td>
<td>Switch fabric</td>
<td>Distributed forwarding with integrated DFC</td>
<td>8</td>
<td>8&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>WS-X6708-10G-3CXL</td>
<td>Switch fabric</td>
<td>Distributed forwarding with integrated DFC</td>
<td>8</td>
<td>8&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

1. The module can be installed in slots 2–6 in the Cisco 7606, slots 2–9 in the Cisco 7609 and OSR-7609, and slots 9–13 in the Cisco 7613 routers. It cannot be installed in slots 2–8 of the Cisco 7613 router. The module requires a Supervisor Engine 720.

Note

These modules are Class 1 laser products. Refer to the Regulatory Compliance and Safety Information for the Cisco 7600 Series Routers for information on working with lasers.

16-Port Gigabit Ethernet Switching Module (WS-X6316-GE-TX)

The 16-port Gigabit Ethernet switching module (WS-X6316-GE-TX) provides 16 switched, full-duplex Gigabit Ethernet ports. (See Figure 2-21.) Ports have RJ-45 connectors for Category 5 UTP. The WS-X6316-GE-TX module has enhanced QoS features.

The QoS port architecture (Rx/Tx) for this module is \(1p1q4t/1p2q2t\).

Figure 2-21 16-Port Gigabit Ethernet Switching Module (WS-X6316-GE-TX)

The front panel LEDs are described in Table 2-3 on page 2-35.

8-Port Gigabit Ethernet Switching Module (WS-X6408-GBIC)

The 8-port Gigabit Ethernet switching module (WS-X6408-GBIC) provides eight switched, full-duplex Gigabit Ethernet ports that you can configure with any combination of 1000BASE-SX, LX/LH, and ZX GBICs, copper GBICs, or Coarse Wave Division Multiplexer (CWDM) GBICs. (See Figure 2-22.)

Note

CWDM GBICs are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the Installation Note for the CWDM Passive Optical System.

The QoS port architecture (Rx/Tx) for this module is \(1q4t/2q2t\).

Figure 2-22 8-Port Gigabit Ethernet Switching Module (WS-X6408-GBIC)

The front panel LEDs are described in Table 2-3 on page 2-35.

8-Port Gigabit Ethernet Switching Module (WS-X6408A-GBIC)

The 8-port Gigabit Ethernet switching module (WS-X6408A-GBIC) provides eight switched, full-duplex Gigabit Ethernet ports that you can configure with any combination of 1000BASE-SX, LX/LH, and ZX GBICs, copper GBICs, or Coarse Wave Division Multiplexer (CWDM) GBICs. (See Figure 2-23.) The WS-X6408A-GBIC module has enhanced QoS features.
Gigabit Ethernet Switching Modules

Chapter 2  Ethernet and Gigabit Ethernet Switching Modules

Gigabit Ethernet Switching Modules

Note

CWDM GBICs are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the Installation Note for the CWDM Passive Optical System.

The QoS port architecture (Rx/Tx) for this module is 1p1q4t/1p2q2t.

Figure 2-23  8-Port Gigabit Ethernet Switching Module (WS-X6408A-GBIC)

The front panel LEDs are described in Table 2-3 on page 2-35.

16-Port Gigabit Ethernet Switching Module (WS-X6416-GBIC)

The 16-port Gigabit Ethernet switching module (WS-X6416-GBIC) provides 16 switched, full-duplex Gigabit Ethernet ports that you can configure with any combination of 1000BASE-SX, LX/LH, and ZX GBICs, copper GBICs, or CWDM GBICs. (See Figure 2-24.) The WS-X6416-GBIC module has enhanced QoS features.

Note

CWDM GBICs are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the Installation Note for the CWDM Passive Optical System.

The QoS port architecture (Rx/Tx) for this module is 1p1q4t/1p2q2t.

Figure 2-24  16-Port Gigabit Ethernet Switching Module (WS-X6416-GBIC)

The front panel LEDs are described in Table 2-3 on page 2-35.

16-Port Gigabit Ethernet Switching Module (WS-X6416-GE-MT)

The 16-port Gigabit Ethernet switching module (WS-X6416-GE-MT) provides 16 switched, 1000-Mbps, full-duplex ports. (See Figure 2-25.) The module has 16 MT-RJ connectors for connecting to MMF cable. The WS-X6416-GE-MT module has enhanced QoS features.

The QoS port architecture (Rx/Tx) for this module is 1p1q4t/1p2q2t.

Figure 2-25  16-Port Gigabit Ethernet Switching Module (WS-X6416-GE-MT)

The front panel LEDs are described in Table 2-3 on page 2-35.
1-Port 10-Gigabit Ethernet Module (WS-X6501-10GEX4)

The 1-port 10-Gigabit Ethernet switching module (WS-X6501-10GEX4) provides one 10-Gigabit Ethernet port accessible through an SC connector on the front panel. (See Figure 2-26.) The WS-X6501-10GEX4 module has a single fabric channel interface. The switching module is upgradable to support distributed forwarding with the installation of an optional Distributed Forwarding Card (WS-F6K-DFC).

![Figure 2-26 1-Port 10-Gigabit Ethernet Module (WS-X6501-10GEX4)](image)

The front panel LEDs are described in Table 2-3 on page 2-35.

1-Port 10-Gigabit Ethernet Base Module (WS-X6502-10GE)

The 1-port 10-Gigabit Ethernet switching module (WS-X6502-10GE) consists of a 10-Gigabit Ethernet Base Module (WS-X6502-10GE) and an Optical Interface Module (OIM). (See Figure 2-27.) The following OIMs are currently available:

- WS-G6483 10GBASE-ER Serial 1550-nm Extended Reach OIM
- WS-G6488 10GBASE-LR Serial 1310-nm Long Haul OIM

The WS-G6483 OIM provides one serial 1550-nm 10-Gigabit Ethernet port through an SC connector. The WS-G6488 OIM provides one serial 1310-nm 10-Gigabit Ethernet port through an SC connector. The switching module is upgradable to support distributed forwarding with an optional Distributed Forwarding Card (WS-F6K-DFC).

The QoS port architecture (Rx/Tx) for this module is 1p1q8t/1p2q1t.

![Figure 2-27 1-Port 10-Gigabit Ethernet Base Module (WS-X6502-10GE) with the WS-G6488 OIM Installed](image)

The front panel LEDs are described in Table 2-3 on page 2-35.

16-Port Gigabit Ethernet Switching Module (WS-X6516-GBIC)

The 16-port Gigabit Ethernet switching module (WS-X6516-GBIC) provides 16 switched, full-duplex Gigabit Ethernet ports that you can configure with any combination of 1000BASE-SX, LX/LH, and ZX GBICs, copper GBICs, or CWDM GBICs. (See Figure 2-28.)

Note

CWDM GBICs are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the Installation Note for the CWDM Passive Optical System.
The WS-X6516-GBIC module has enhanced QoS features. The QoS port architecture (Rx/Tx) for this module is \(1p1q4t/1p2q2t\).

The WS-X6516-GBIC module has a single fabric channel interface. The switching module is upgradable to support distributed forwarding by installing an optional Distributed Forwarding Card (WS-F6K-DFC).

**Figure 2-28 16-Port Gigabit Ethernet Switching Module (WS-X6516-GBIC)**

The front panel LEDs are described in Table 2-3 on page 2-35.

**16-Port Gigabit Ethernet Switching Module (WS-X6516A-GBIC)**

The 16-port Gigabit Ethernet switching module (WS-X6516A-GBIC) provides 16 switched, full-duplex Gigabit Ethernet ports that you can configure with any combination of 1000BASE-SX, LX/LH, and ZX GBICs, copper GBICs, or CWDM GBICs. (See Figure 2-28.)

Note

CWDM GBICs are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the Installation Note for the CWDM Passive Optical System.

The WS-X6516A-GBIC module has enhanced QoS features. The QoS port architecture (Rx/Tx) for this module is \(1p1q4t/1p2q2t\). The module has 1 MB per port buffers.

The WS-X6516A-GBIC module has a single fabric channel interface. The switching module is upgradable to support distributed forwarding by installing an optional Distributed Forwarding Card (WS-F6K-DFC).

**Figure 2-29 16-Port Gigabit Ethernet Switching Module (WS-X6516A-GBIC)**

The front panel LEDs are described in Table 2-3 on page 2-35.

**16-Port 10/100/1000BASE-T Gigabit Ethernet Switching Module (WS-X6516-GE-TX)**

The 16-port Gigabit Ethernet switching module (WS-X6516-GE-TX) provides 16 switched, 10/100/1000BASE-T Gigabit Ethernet ports. (See Figure 2-30.) The ports have RJ-45 connectors for Category 5 UTP. The WS-X6516-GE-TX module has a single fabric channel interface. The switching module is upgradable to support distributed forwarding by installing an optional Distributed Forwarding Card (WS-F6K-DFC).

The QoS port architecture (Rx/Tx) for this module is \(1p1q4t/1p2q2t\).
Figure 2-30  16-Port 10/100/1000BASE-T Gigabit Ethernet Switching Module (WS-X6516-GE-TX)

The front panel LEDs are described in Table 2-3 on page 2-35.

4-Port 10 Gigabit Ethernet Switching Module (WS-X6704-10GE)

The 4-port 10-Gigabit Ethernet switching module (WS-X6704-10GE) provides 4 switched, 10-Gigabit Ethernet ports. (See Figure 2-31.) The four ports support hot-swappable 10GBASE-LR long-reach or 10GBASE-ER extended reach XenPak optical transceivers. The WS-X6704-10GE module has dual fabric channel interface and requires the Supervisor Engine 720.

The QoS port architecture (Rx/Tx) for this module is 1q8t/1p7q8t.

Figure 2-31  4-Port 10 Gigabit Ethernet Switching Module (WS-X6704-10GE)

The front panel LEDs are described in Table 2-3 on page 2-35.

24-Port Gigabit Ethernet Switching Module (WS-X6724-SFP)

The 24-port Gigabit Ethernet switching module (WS-X6724-SFP) provides 24 switched, Gigabit Ethernet ports. (See Figure 2-32.) The 24 ports support hot-swappable Small Form-Factor Pluggable (SFP) 1000BASE-SX, 1000BASE-LX/LH, and 1000BASE-ZX optical transceivers. The WS-X6724-SFP module has single fabric channel interface and requires the Supervisor Engine 720.

The QoS port architecture (Rx/Tx) for this module is 1q8t/1p3q8t.

Figure 2-32  24-Port Gigabit Ethernet Switching Module (WS-X6724-SFP)

The front panel LEDs are described in Table 2-3 on page 2-35.

48-Port Gigabit Ethernet Switching Module (WS-X6748-SFP)

The 48-port Gigabit Ethernet switching module (WS-X6748-SFP) provides 48 switched, Gigabit Ethernet ports. (See Figure 2-33.) The 48 ports support hot-swappable Small Form-Factor Pluggable (SFP) 1000BASE-SX, 1000BASE-LX/LH, and 1000BASE-ZX optical transceivers. The WS-X6748-SFP module has a dual fabric channel interface and requires the Supervisor Engine 720.

The QoS port architecture (Rx/Tx) for this module is 1q8t/1p3q8t.
Chapter 2      Ethernet and Gigabit Ethernet Switching Modules

Gigabit Ethernet Switching Modules

Figure 2-33  48-Port Gigabit Ethernet Switching Module (WS-X6748-SFP)

The front panel LEDs are described in Table 2-3 on page 2-35.

16-Port Gigabit Ethernet Switching Module (WS-X6816-GBIC)

The 16-Port Gigabit Ethernet switching module (WS-X6816-GBIC) provides 16 switched, full-duplex Gigabit Ethernet ports that you can configure with any combination of 1000BASE-SX, LX/LH, and ZX GBICs, copper GBICs, or CWDM GBICs. (See Figure 2-34.)

Note

CWDM GBICs are used with the CWDM Passive Optical System. For more information on the CWDM Passive Optical System, refer to the Installation Note for the CWDM Passive Optical System.

The WS-X6816-GBIC is a fabric-dependent module that has enhanced QoS features. The QoS port architecture (Rx/Tx) for this module is 1p1q4t/1p2q2t.

The WS-X6816-GBIC module has the following installation restrictions:

- The WS-X6816-GBIC requires a Supervisor Engine 2 or Supervisor Engine 720.

Note

The WS-X6816-GBIC must have a DFC3A daughter card installed to operate with the Supervisor Engine 720.

- A Switch Fabric Module must be installed in the Cisco 7600 series routers chassis when a WS-X6816-GBIC module is installed.
- The WS-X6816-GBIC can be installed in slots 2 through 6 in the Cisco 7606 router.
- The WS-X6816-GBIC can be installed in slots 2 through 9 in the Cisco 7609 router.
- The WS-X6816-GBIC can only be installed in slots 9 through 13 in the Cisco 7613 router; it cannot be installed in slots 2 through 8.

Figure 2-34  16-Port Gigabit Ethernet Switching Module (WS-X6816-GBIC)

The front panel LEDs are described in Table 2-3 on page 2-35.

8-Port Gigabit Ethernet Switching Module (WS-X6708-10G-3C)

The 8-Port Gigabit Ethernet Switching Module (WS-X6708-10G-3C) comprises a WS-X6708-10GE base board and a distributed forwarding card (WS-F6700-DFC3C). The base module supports up to eight pluggable X2 optics and has a 40 Gbps connection to the fabric and is therefore 2:1 oversubscribed. The
distributed forwarding card provides hardware-based MAC learning and forwards traffic at 48 Mpps. The 8-port 10 Gigabit Ethernet module can demonstrate 60 Gbps local switching. Besides increased port density, it also has increased port buffering and enhanced queueing and scheduling mechanisms for congestion management.

The 8-Port Gigabit Ethernet Switching Module (WS-X6708-10G-3C) supports the following optics: X2-10GB-SR, X2-10GB-LR, X2-10GB-ER, X2-10GB-LX4, and X2-10GB-CX4.

The QoS port architecture (Rx/Tx) for this module is $8q4t/1p7q4t$.

**Figure 2-35** 8-Port Gigabit Ethernet Switching Module (WS-X6708-10G-3C)

The front panel LEDs are described in Table 2-3 on page 2-35.

### 8-Port Gigabit Ethernet Switching Module (WS-X6708-10G-3CXL)

The 8-Port Gigabit Ethernet Switching Module (WS-X6708-10G-3CXL) comprises a WS-X6708-10GE base board and a distributed forwarding card (WS-F6700-DFC3CXL). The base module supports up to eight pluggable X2 optics and has a 40 Gbps connection to the fabric and is therefore 2:1 oversubscribed. The distributed forwarding card provides hardware-based MAC learning and forwards traffic at 48 Mpps. The 8-port 10 Gigabit Ethernet module can demonstrate 60 Gbps local switching. Besides increased port density, it also has increased port buffering and enhanced queueing and scheduling mechanisms for congestion management.

The 8-Port Gigabit Ethernet Switching Module (WS-X6708-10G-3CXL) supports the following optics: X2-10GB-SR, X2-10GB-LR, X2-10GB-ER, X2-10GB-LX4, and X2-10GB-CX4.

The QoS port architecture (Rx/Tx) for this module is $8q4t/1p7q4t$.

**Figure 2-36** 8-Port Gigabit Ethernet Switching Module (WS-X6708-10G-3C)

The front panel LEDs are described in Table 2-3 on page 2-35.

### Ethernet Module LEDs

The Ethernet and Gigabit Ethernet module front-panel LEDs are described in Table 2-3.

**Table 2-3** Ethernet and Gigabit Ethernet Module LEDs

<table>
<thead>
<tr>
<th>LED</th>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>Green</td>
<td>All diagnostics pass; the module is operational.</td>
</tr>
</tbody>
</table>
### Ethernet and Gigabit Ethernet Module LEDs (continued)

<table>
<thead>
<tr>
<th>LED</th>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange</td>
<td>The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.)</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online.</td>
<td></td>
</tr>
<tr>
<td>Off</td>
<td>The module is not receiving power.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 2-3  Ethernet and Gigabit Ethernet Module LEDs (continued)

<table>
<thead>
<tr>
<th>LED</th>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINK</td>
<td>Green</td>
<td>The port is active (the link is connected and operational).</td>
</tr>
<tr>
<td></td>
<td>Orange</td>
<td>The module or port is disabled through the CLI command or the module is initializing.</td>
</tr>
<tr>
<td></td>
<td>Flashing orange</td>
<td>The port is faulty and has been disabled.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>The port is not active or the link is not connected.</td>
</tr>
<tr>
<td>PHONE</td>
<td>Green</td>
<td>The voice daughter card is installed.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>The voice daughter card is not detected or is not installed.</td>
</tr>
</tbody>
</table>

1. This is a good time to verify that all LINK LEDs are functioning.
ATM Modules

This chapter describes the ATM Modules, and it contains the following sections

- 1-Port OC-12 ATM Module (WS-X6101-OC12-MMF), page 3-1
- 1-Port OC-12 ATM Module (WS-X6101-OC12-SMF), page 3-2
- ATM Module LEDs, page 3-3

Note: These modules are Class 1 laser products. Refer to the Regulatory Compliance and Safety Information for the Cisco 7600 Series Routers for information on working with lasers.

1-Port OC-12 ATM Module (WS-X6101-OC12-MMF)

The 1-port ATM module (WS-X6101-OC12-MMF) provides one direct connection and one standby connection between the ATM network and the switch using two multimode, SC, fiber-optic connectors. (See Figure 3-1.)

The CONSOLE PORT allows you to access the switch either locally (with a console terminal) or remotely (with a modem). The CONSOLE PORT is an EIA/TIA-232 asynchronous, serial connection with hardware flow control and an RJ-45 connector.

The CONSOLE PORT mode switch allows you to attach either a terminal or a modem to the CONSOLE PORT.

Note: Use a ballpoint pen tip or other small, pointed object to access the CONSOLE PORT MODE switch.

Use the CONSOLE PORT MODE switch as follows:

- Mode 1—Switch in the \textit{in} position (factory default). Use this mode to connect a terminal to the console port using a console cable and a DTE adapter. You can also use this mode to connect a modem to the console port.
- Mode 2—Switch in the \textit{out} position. This mode is not supported in the Cisco 7600 series routers.
1-Port OC-12 ATM Module (WS-X6101-OC12-SMF)

The 1-port ATM module (WS-X6101-OC12-SMF) provides one direct connection and one standby connection between the ATM network and the switch using two single-mode, SC, fiber-optic connectors. (See Figure 3-2.)

The CONSOLE PORT allows you to access the switch either locally (with a console terminal) or remotely (with a modem). The CONSOLE PORT is an EIA/TIA-232 asynchronous, serial connection with hardware flow control and an RJ-45 connector.

The CONSOLE PORT MODE switch allows you to attach either a terminal or a modem to the console port.

**Note**

Use a ballpoint pen tip or other small, pointed object to access the CONSOLE PORT MODE switch.

Use the CONSOLE PORT MODE switch as follows:

- Mode 1—Switch in the *in* position (factory default). Use this mode to connect a terminal to the CONSOLE PORT using a console cable and a DTE adapter. You can also use this mode to connect a modem to the console port.
- Mode 2—Switch in the *out* position. Use this mode to connect a terminal to the CONSOLE PORT using the Catalyst 5000 family Supervisor Engine III console cable (not provided).

The front panel LEDs are described in Table 3-1 on page 3-3.
The ATM module front-panel LEDs are described in Table 3-1.

Table 3-1  ATM Module LEDs

<table>
<thead>
<tr>
<th>LED</th>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>Green</td>
<td>All diagnostics pass; the module is operational.</td>
</tr>
<tr>
<td></td>
<td>Orange</td>
<td>The module is booting or running diagnostics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A fault occurred during the initialization sequence.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.)</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>The module is resetting. (The switch has just been powered on or the module has been hot inserted.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>The module is not receiving power.</td>
</tr>
<tr>
<td>TX (transmit)</td>
<td>Green</td>
<td>The port is transmitting a packet (the LED is lit for approximately 50 milliseconds).</td>
</tr>
<tr>
<td>RX (receive)</td>
<td>Green</td>
<td>The port is receiving a packet (the LED is lit for approximately 50 milliseconds).</td>
</tr>
<tr>
<td>LINK</td>
<td>Green</td>
<td>The port is active (the link is connected and operational).</td>
</tr>
<tr>
<td></td>
<td>Orange</td>
<td>The module or port is disabled through the CLI command or the module is initializing.</td>
</tr>
<tr>
<td></td>
<td>Flashing orange</td>
<td>The port is faulty and has been disabled.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>The port is not active or the link is not connected.</td>
</tr>
<tr>
<td>ACTIVE</td>
<td>Green</td>
<td>The port is active (the link is connected and operational).</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>The port is the standby port.</td>
</tr>
<tr>
<td>SIGNAL</td>
<td>Green</td>
<td>The active port is receiving a valid signal level through the fiber-optic cable; this condition does not indicate valid framing.</td>
</tr>
</tbody>
</table>
CHAPTER 4

FlexWAN Module and Enhanced FlexWAN Modules

This chapter describes the FlexWAN and Enhanced FlexWAN modules.

The FlexWAN and Enhanced FlexWAN modules are installed in a Catalyst 6500 series switch or Cisco 7600 series router that has a supervisor engine with a Multilayer Switch Feature Card (MSFC) and Policy Feature Card (PFC). The MSFC, in conjunction with the Enhanced FlexWAN module, provides multiprotocol routing support with full Internet route connectivity for speeds ranging from serial RS-232 to OC-3. The FlexWAN and Enhanced FlexWAN modules can accept up to two Cisco 7200/7500 WAN port adapters, which deliver WAN consolidation and extend quality of service (QoS) and traffic management capabilities over WAN segments. The FlexWAN and Enhanced FlexWAN modules support ATM and POS OC-3 links and channelized, clear-channel port adapters at speeds from DS0 to T3/E3.

The Enhanced FlexWAN module also provides connectivity to the crossbar fabric and enhancements in processor speed and onboard memory.

Table 4-1 shows the port adapters supported on the FlexWAN module.

<p>| Note | A FlexWAN or Enhanced FlexWAN module without port adapters inserted is not a supported configuration. |</p>
<table>
<thead>
<tr>
<th>Group</th>
<th>Port Adapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATM (with traffic shaping)</td>
<td>PA-A6-OC3MM</td>
</tr>
<tr>
<td></td>
<td>PA-A6-OC3SMI</td>
</tr>
<tr>
<td></td>
<td>PA-A6-OC3SML</td>
</tr>
<tr>
<td></td>
<td>PA-A6-T3</td>
</tr>
<tr>
<td></td>
<td>PA-A6-E3</td>
</tr>
<tr>
<td></td>
<td>PA-A3-OC3MM</td>
</tr>
<tr>
<td></td>
<td>PA-A3-OC3SMI</td>
</tr>
<tr>
<td></td>
<td>PA-A3-OC3SML</td>
</tr>
<tr>
<td></td>
<td>PA-A3-T3</td>
</tr>
<tr>
<td></td>
<td>PA-A3-E3</td>
</tr>
<tr>
<td></td>
<td>PA-A3-IMA-T1/E1</td>
</tr>
<tr>
<td>HSSI</td>
<td>PA-H</td>
</tr>
<tr>
<td></td>
<td>PA-2H</td>
</tr>
<tr>
<td>Packet over Sonet (OC-3)</td>
<td>PA-POS-OC3MM</td>
</tr>
<tr>
<td></td>
<td>PA-POS-OC3SMI</td>
</tr>
<tr>
<td></td>
<td>PA-POS-OC3SML</td>
</tr>
<tr>
<td></td>
<td>PA-POS-2OC3</td>
</tr>
<tr>
<td></td>
<td>PA-POS-1OC3</td>
</tr>
<tr>
<td>T1/E1</td>
<td>PA-4T+</td>
</tr>
<tr>
<td></td>
<td>PA-8T-V35</td>
</tr>
<tr>
<td></td>
<td>PA-8T-X21</td>
</tr>
<tr>
<td></td>
<td>PA-8T-232</td>
</tr>
<tr>
<td></td>
<td>PA-MC-2E1/120</td>
</tr>
<tr>
<td></td>
<td>PA-MC-2T1</td>
</tr>
<tr>
<td></td>
<td>PA-MC-4T1</td>
</tr>
<tr>
<td></td>
<td>PA-MC-8T1</td>
</tr>
<tr>
<td></td>
<td>PA-MC-8E1/120</td>
</tr>
<tr>
<td></td>
<td>PA-MC-8TE1+</td>
</tr>
<tr>
<td></td>
<td>PA-MC-STM-1</td>
</tr>
<tr>
<td>T3/E3 (clear-channel and channelized)</td>
<td>PA-T3</td>
</tr>
<tr>
<td></td>
<td>PA-2T3</td>
</tr>
<tr>
<td></td>
<td>PA-T3+</td>
</tr>
<tr>
<td></td>
<td>PA-2T3+</td>
</tr>
<tr>
<td></td>
<td>PA-E3</td>
</tr>
<tr>
<td></td>
<td>PA-2E3</td>
</tr>
<tr>
<td></td>
<td>PA-MC-T3</td>
</tr>
<tr>
<td></td>
<td>PA-MC-2T3+</td>
</tr>
<tr>
<td></td>
<td>PA-MC-E3</td>
</tr>
<tr>
<td>Fast Ethernet 1 2</td>
<td>PA-1FE-FX</td>
</tr>
<tr>
<td></td>
<td>PA-1FE-TX</td>
</tr>
<tr>
<td></td>
<td>PA-2FE-FX</td>
</tr>
<tr>
<td></td>
<td>PA-2FE-TX</td>
</tr>
</tbody>
</table>

1. Supported on the Enhanced FlexWAN module only.
2. The option to configure the interface as Layer 2 port is not supported on the Enhanced FlexWAN module.
For more information about the MSFC and PFC, refer to the appropriate Cisco 7600 Series Cisco IOS Software Configuration Guide for your software release.

**Note**

Throughout this publication, except where noted, the term MSFC refers to both MSFC and MSFC2, and the term PFC refers to both PFC and PFC2.

**Note**

To use the FlexWAN and Enhanced FlexWAN modules, you must have a supervisor engine with an MSFC and a PFC. You configure the FlexWAN and Enhanced FlexWAN modules through the MSFC.

The STATUS LED on the FlexWAN and Enhanced FlexWAN modules front panel (see Figure 4-1) indicates the status of the FlexWAN module. Table 4-2 describes the LED operation.

For information on FlexWAN and Enhanced FlexWAN modules hardware and software requirements and port adapter installation and configuration, refer to the FlexWAN and Enhanced FlexWAN Modules Installation and Configuration Guide and to the FlexWAN & Enhanced FlexWAN Installation Guide.

**Figure 4-1** FlexWAN Module (WS-X6182-2PA) and Enhanced FlexWAN Module (WS-X6582-2PA) Front Panel

![FlexWAN Module Front Panel](image)

**Table 4-2** FlexWAN and Enhanced FlexWAN Modules LED Description

<table>
<thead>
<tr>
<th>LED</th>
<th>Color/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>The STATUS LED shows the module status:</td>
</tr>
<tr>
<td></td>
<td>• Normal initialization sequence</td>
</tr>
<tr>
<td></td>
<td>- Orange—Module is booting or running diagnostics</td>
</tr>
<tr>
<td></td>
<td>- Green—All diagnostics pass, module is operational</td>
</tr>
<tr>
<td></td>
<td>• Fault during initialization sequence</td>
</tr>
<tr>
<td></td>
<td>- Orange—Module is booting or running diagnostics</td>
</tr>
<tr>
<td></td>
<td>- Red—Diagnostic test fails, module is not operational</td>
</tr>
<tr>
<td></td>
<td>• Environmental monitoring</td>
</tr>
<tr>
<td></td>
<td>- Orange—Over temperature condition (minor threshold exceeded)</td>
</tr>
<tr>
<td></td>
<td>- Red—Over temperature condition (major threshold exceeded)</td>
</tr>
</tbody>
</table>

**Note**

The FlexWAN or Enhanced FlexWAN module status LED displays red on initial power-up and then displays orange.
Note
STATUS LED off indicates the module has been powered off with the no power enable command or is faulty.

Note
For detailed information about port adapter LEDs, refer to the documentation that shipped with your port adapter.
Multilayer Switch Module

This chapter describes the Multilayer Switch Module (MSM) (WS-X6302-MSM). The Multilayer Switch Module provides multiprotocol routing for the switch Ethernet interfaces. Cisco IOS features available for the MSM are listed in Table 5-1.

Table 5-1 Cisco IOS Features for the Multilayer Switch Module

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer 3 forwarding</td>
<td>• Wire speed IP, IP multicast, and IPX routing between VLANs</td>
</tr>
<tr>
<td></td>
<td>• Support for up to 64K entries for IP network prefixes, IP unicast</td>
</tr>
<tr>
<td></td>
<td>and multicast addresses, IPX network numbers, and MAC addresses</td>
</tr>
<tr>
<td></td>
<td>• IP precedence-based IP forwarding</td>
</tr>
<tr>
<td></td>
<td>• Forwarding information base (FIB) and adjacency database support as defined</td>
</tr>
<tr>
<td></td>
<td>in other Cisco routers</td>
</tr>
<tr>
<td></td>
<td>• Destination or destination/source-based load sharing among equal cost</td>
</tr>
<tr>
<td></td>
<td>paths</td>
</tr>
<tr>
<td>Layer 3 routing protocols</td>
<td>• Static IP routing</td>
</tr>
<tr>
<td></td>
<td>• IP routing protocols such as Internet Group Management Protocol (IGRP),</td>
</tr>
<tr>
<td></td>
<td>Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path</td>
</tr>
<tr>
<td></td>
<td>First (OSPF), Routing Information Protocol (RIP), and RIP-2</td>
</tr>
<tr>
<td></td>
<td>• IP multicast routing protocols such as Protocol Independent Multicast</td>
</tr>
<tr>
<td></td>
<td>(PIM) (sparse and dense mode) and Distance Vector Multicast Routing</td>
</tr>
<tr>
<td></td>
<td>Protocol (DVMRP)</td>
</tr>
<tr>
<td></td>
<td>• IPX routing protocols such as RIP and EIGRP</td>
</tr>
</tbody>
</table>
Chapter 5      Multilayer Switch Module

The MSM front panel features are shown in Figure 5-1 and are described in Table 5-2.

**Figure 5-1    Multilayer Switch Module (WS-X6302-MSM)**

The STATUS LED shows the results of the initialization and its dialog with the supervisor engine. Table 5-2 describes the LED operation.

**Table 5-2   Multilayer Switch Module STATUS LED**

<table>
<thead>
<tr>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>All diagnostics pass; the module is operational.</td>
</tr>
<tr>
<td>Orange</td>
<td>The module is booting or running diagnostics.</td>
</tr>
<tr>
<td></td>
<td>An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.)</td>
</tr>
<tr>
<td>Red</td>
<td>A diagnostic test has failed; the module is not operational.</td>
</tr>
<tr>
<td></td>
<td>An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.)</td>
</tr>
</tbody>
</table>

The CONSOLE PORT MODE switch allows you to connect a terminal to the MSM using the console cable and adapters provided with the router. You also can connect a modem to the console port using the cable and adapter provided with the router.
Use a paper clip or a small, pointed object to access the CONSOLE PORT MODE switch.

Use the CONSOLE PORT MODE switch as follows:

- **Mode 1**—Place the switch in the in position (factory default position) to connect a terminal to the console port using the console cable and DTE adapter (labeled “Terminal”) that shipped with the router.

  You can also use this mode to connect a modem to the console port using the console cable and DCE adapter (labeled “Modem”) that shipped with the switch.

- **Mode 2**—Not supported.
Network Analysis Modules

This chapter describes the Network Analysis Modules (NAMs) and contains the following sections:

- Network Analysis Module (WS-SVC-NAM-1), page 6-1
- Network Analysis Module (WS-SVC-NAM-2), page 6-2

NAMs monitor and analyze network traffic for the Cisco 7600 series routers using Remote Monitoring (RMON), RMON2, and other MIBs. The RMON support that the NAM provides for Ethernet VLANs is an extension of the RMON support provided by the supervisor engine. The switched port analyzer (SPAN) selects network traffic and directs it to the NAM. TrafficDirector, or any other IETF-compliant RMON application, can analyze link characteristics, packet layers for capacity planning or departmental accounting, differentiated service deployment and policies, and filter/capture packets for debugging.

Note
Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

Network Analysis Module (WS-SVC-NAM-1)

The Network Analysis Module (WS-SVC-NAM-1) provides integrated network monitoring services within the router. The NAM collects network traffic statistics for real-time traffic analysis, performance monitoring, and troubleshooting.

The NAM monitors and analyzes network traffic for the Cisco 7600 series routers using remote monitoring (RMON), RMON extensions for switched networks (SMON), and other management information bases (MIBs). The NAM supports the following RMON groups:

- RMON groups defined in RFC 1757
- RMON2 groups defined in RFC 2021

The NAM also can monitor individual Ethernet VLANs, which allows it to serve as an extension to the basic RMON support provided by the supervisor engine.

You can use any other IETF-compliant RMON application to access link, host, protocol, and response-time statistics for capacity planning, departmental accounting, and real-time application protocol monitoring. You also can use filters and capture buffers to troubleshoot the network.

The NAM can analyze Ethernet VLAN traffic from one or both of the following sources:

- Ethernet, Fast Ethernet, Gigabit Ethernet, trunk port, or Fast EtherChannel SPAN or RSPAN source port
For more information about SPAN and RSPAN, refer to the “Configuring SPAN and RSPAN” chapter in the appropriate Cisco 7600 Series Cisco IOS Software Configuration Guide.

Note
Cisco IOS software currently does not support RSPAN.

- Netflow Data Export (NDE)

For more information about NDE, refer to the Cisco 7600 Series Cisco IOS Software Configuration Guide.

The NAM-1 module has 512 MB of RAM and a 96 MB capture buffer.

The front panel LEDs are shown in Figure 6-1 and described in Table 6-1.

Figure 6-1 Network Analysis Module (WS-SVC-NAM-1)

Table 6-1 NAM-1 Module STATUS LED Description

<table>
<thead>
<tr>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>All diagnostic tests pass. The NAM is operational.</td>
</tr>
<tr>
<td>Red</td>
<td>A diagnostic other than an individual port test failed.</td>
</tr>
<tr>
<td>Orange</td>
<td>Indicates one of three conditions:</td>
</tr>
<tr>
<td></td>
<td>• The NAM is running through its boot and self-test diagnostic sequence.</td>
</tr>
<tr>
<td></td>
<td>• The NAM is disabled.</td>
</tr>
<tr>
<td></td>
<td>• The NAM is in the shutdown state.</td>
</tr>
<tr>
<td>Off</td>
<td>The NAM is powered off.</td>
</tr>
</tbody>
</table>

The SHUTDOWN button is used to manually shut down the NAM. To prevent corruption of the NAM, it is critical that the NAM run through the shutdown procedure before shutting off. If the NAM fails to respond to CLI or NAM shutdown commands, you can use the SHUTDOWN button as an alternative shutdown method.

For information on NAM module hardware and software requirements and port adapter installation and configuration, refer to the Catalyst 6500 Series Switch and Cisco 7600 Series Router Network Analysis Module Release 3.4 Configuration Note.

Network Analysis Module (WS-SVC-NAM-2)

The Network Analysis Module (WS-SVC-NAM-2) provides integrated network monitoring services within the router. (See Figure 6-2.) The NAM collects network traffic statistics for real-time traffic analysis, performance monitoring, and troubleshooting.
The NAM monitors and analyzes network traffic for the Cisco 7600 series routers using remote monitoring (RMON), RMON extensions for switched networks (SMON), and other management information bases (MIBs). The NAM supports the following RMON groups:

- RMON groups defined in RFC 1757
- RMON2 groups defined in RFC 2021

The NAM also can monitor individual Ethernet VLANs, which allows it to serve as an extension to the basic RMON support provided by the supervisor engine.

You can use any other IETF-compliant RMON application to access link, host, protocol, and response-time statistics for capacity planning, departmental accounting, and real-time application protocol monitoring. You also can use filters and capture buffers to troubleshoot the network.

The NAM can analyze Ethernet VLAN traffic from one or both of the following sources:

- Ethernet, Fast Ethernet, Gigabit Ethernet, trunk port, or Fast EtherChannel SPAN or RSPAN source port
  
  For more information about SPAN and RSPAN, refer to the “Configuring SPAN and RSPAN” chapter in the *Cisco 7600 Series Cisco IOS Software Configuration Guide*.

- Netflow Data Export (NDE)
  
  For more information about NDE, refer to the *Cisco 7600 Series Cisco IOS Software Configuration Guide*.

The NAM-2 module has 1 GB of RAM and a 128 MB capture buffer.

The front panel LEDs are shown in Figure 6-2 and described in Table 6-2.

**Figure 6-2**  Network Analysis Module (WS-SVC-NAM-2)

**Table 6-2**  NAM-2 Module STATUS LED Description

<table>
<thead>
<tr>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>All diagnostic tests pass. The NAM is operational.</td>
</tr>
<tr>
<td>Red</td>
<td>A diagnostic other than an individual port test failed.</td>
</tr>
<tr>
<td>Orange</td>
<td>Indicates one of three conditions:</td>
</tr>
<tr>
<td></td>
<td>- The NAM is running through its boot and self-test diagnostic sequence.</td>
</tr>
<tr>
<td></td>
<td>- The NAM is disabled.</td>
</tr>
<tr>
<td></td>
<td>- The NAM is in the shutdown state.</td>
</tr>
<tr>
<td>Off</td>
<td>The NAM is powered off.</td>
</tr>
</tbody>
</table>

**Note**  Cisco IOS software currently does not support RSPAN.
The SHUTDOWN button is used to manually shut down the NAM. To prevent corruption of the NAM, it is critical that the NAM run through the shutdown procedure before shutting off. If the NAM fails to respond to CLI or NAM shutdown commands, you can use the SHUTDOWN button as an alternative shutdown method.

For information on NAM module hardware and software requirements and port adapter installation and configuration, refer to the *Catalyst 6500 Series Switch and Cisco 7600 Series Router Network Analysis Module Release 3.4 Configuration Note*. 
CHAPTER 7

Firewall Services Module

This chapter describes the Firewall Services Module (WS-SVC-FWM-1-K9).

The Firewall Services Module protects an internal (inside) network from unauthorized access by users on an external (outside) network, such as the public Internet.

Note

Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

Note

The term inside refers to networks or network resources protected by the firewall. The term outside refers to networks not protected by the firewall.

The Firewall Services Module has the following features:

- Multiple modules—Supports multiple Firewall Services Modules in a Cisco 7600 series routers chassis.
- Switch fabric-compatible.
- Interface configuration—Performed though native IOS CLI.
- URL filtering enhancement—The module checks the outgoing URL requests with the policy defined on a Websense Windows NT or UNIX-based server. Depending on the response from the server, which matches a request against a list of 17 website characteristics that are considered inappropriate for business use, the module either permits or denies the connection.
- Security—Cisco firewalls provide the latest in security technology ranging from stateful inspection firewalls to content filtering capabilities that help protect your network environment from future attacks. Another security feature is the adaptive security algorithm (ASA), which maintains the firewalled areas between the networks controlled by the firewall.

The stateful, connection-oriented ASA creates session flows based on source and destination addresses, TCP sequence numbers (which are nonpredictable), port numbers, and additional TCP flags. You can control all inbound and outbound traffic by applying security policies to each connection table entry.

- Performance—With support for up to 6 gigabits of throughput, firewalls can provide protection in the most demanding network environments.
- Reliability—Cisco firewalls provide adaptable security services for operation-critical network environments by using the integrated stateful failover capabilities within the Firewall Services Module. Network traffic can be automatically sent to a hot-standby module in the event of a failure, while maintaining concurrent connections with automated state synchronization between the primary module and the standby module.

- Network Address Translation (NAT) and Port Address Translation (PAT)—Cisco firewalls provide NAT and PAT services that conceal IP addresses of internal networks and expand network address space for internal networks.

- Denial-of-service (DoS) attack prevention—Cisco firewalls protect the firewall and networks behind them from attempts to gain access, which can bring a network to a halt.

- Scalability—Up to two modules are supported in a single Cisco 7600 series router chassis.

The following PIX firewall features are not supported by the module:

- Virtual private networks (VPN) (the module supports IPSec VPN only for management purposes.)
- Intrusion detection system (IDS) syslog messages
- PIX Firewall Manager (PFM)
- CSPM
- Conduit
- DHCP client

The front panel LEDs are shown in Figure 7-1 and described in Table 7-1.

![Firewall Services Module (WS-SVC-FWM-1-K9)](image)

**Figure 7-1** Firewall Services Module (WS-SVC-FWM-1-K9)

<table>
<thead>
<tr>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>All diagnostic tests pass. The module is operational.</td>
</tr>
<tr>
<td>Red</td>
<td>A diagnostic test other than an individual port test failed.</td>
</tr>
<tr>
<td>Orange</td>
<td>Indicates one of three conditions:</td>
</tr>
<tr>
<td></td>
<td>- The module is running through its boot and self-test diagnostic sequence.</td>
</tr>
<tr>
<td></td>
<td>- The module is disabled.</td>
</tr>
<tr>
<td></td>
<td>- The module is in the shutdown state.</td>
</tr>
<tr>
<td>Off</td>
<td>The firewall module power is off.</td>
</tr>
</tbody>
</table>

**Table 7-1** Firewall Services Module STATUS LED Description
The SHUTDOWN button is used to manually shut down the Firewall Services Module. To prevent corruption of the module, it is critical that the module run through the shutdown procedure before shutting off. If the module fails to respond to CLI or NAM shutdown commands, you can use the SHUTDOWN button as an alternative shutdown method.

For further information on the Firewall Services Module, refer to the *Catalyst 6500 Series Switch and Cisco 7600 Series Router Firewall Services Module Configuration Guide, 2.3.*
IPSec VPN Acceleration Services Module

This chapter describes the IPSec VPN Acceleration Services Module (WS-SVC-IPSEC-1). The IPSec VPN Acceleration Services module is a Gigabit Ethernet IPSec cryptographic module that you can install in the Cisco 7600 series routers. (See Figure 8-1.) The VPN module provides bump-in-the-wire (BITW) IPSec implementation using VLANs.

**Note**
BITW is an IPSec implementation that starts egress packet processing after the IP stack has finished with the packet, and completes ingress packet processing before the IP stack receives the packet.

**Note**
Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

**Figure 8-1  IPSec VPN Acceleration Services Module (WS-SVC-IPSEC-1)**

Configuring VPNs using the VPN module is similar to configuring VPNs on routers running Cisco IOS software. When you configure VPNs with the VPN module, you attach crypto maps to VLANs (using interface VLANs); when you configure VPNs on routers running Cisco IOS software, you configure individual interfaces.

**Note**
With the VPN module, crypto maps are still attached to individual interfaces, but the set of interfaces allowed is restricted to “interface VLANs.”

When you configure a VPN on the Cisco routers, a packet is sent to a routed interface that is associated with an IP address. If the interface has an attached crypto map, the software checks that the packet is on an access control list (ACL) specified by the crypto map. If a match occurs, the packet is transformed (encrypted) before it is routed to the appropriate IPSec peer; otherwise, the packet is routed in the clear (unencrypted) state.
When you configure the VPN module, the same cryptographic operations are performed as on Cisco routers. The VPN module’s implementation of VPN is generally the same as on Cisco routers other than the use of interface VLANs and some configuration guidelines specific to the VPN module.

**Note**
For detailed information on Cisco IOS IPSec cryptographic operations and policies, refer to the “IP Security and Encryption” section of the *Cisco IOS Security Configuration Guide*, Release 12.2.

When you configure the VPN module on the Cisco 7600 series routers, you ensure that all packets coming from or going to the Internet pass through the VPN module. The VPN module has an extensive set of policies that validate a packet before the packet is sent onto the local (trusted) LAN. The VPN module can use multiple Fast Ethernet or Gigabit Ethernet ports on other Cisco 7600 series routers modules to connect to the Internet. Packets received from the WAN routers pass through the VPN module for IPSec processing.

On the local LAN side, traffic between the LAN ports can be routed or bridged on multiple Fast Ethernet or Gigabit Ethernet ports. Because the local LAN traffic is not encrypted or decrypted, it does not pass though the VPN module.

The VPN module does not maintain routing information, route, or change the MAC header of a packet (except for the VLAN ID from one VLAN to another).

The front panel LED on the IPSec VPN Acceleration Services Module is described in Table 8-1.

**Table 8-1  IPSec VPN Acceleration Services Module STATUS LED**

<table>
<thead>
<tr>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>All diagnostic tests pass. The module is operational.</td>
</tr>
<tr>
<td>Red</td>
<td>A diagnostic test other than an individual port test failed.</td>
</tr>
<tr>
<td>Orange</td>
<td>Indicates one of three conditions:</td>
</tr>
<tr>
<td></td>
<td>• The module is running through its boot and self-test diagnostic sequence.</td>
</tr>
<tr>
<td></td>
<td>• The module is disabled.</td>
</tr>
<tr>
<td></td>
<td>• The module is in the shutdown state.</td>
</tr>
<tr>
<td>Off</td>
<td>The module power is off.</td>
</tr>
</tbody>
</table>
Intrusion Detection System Module

This chapter describes the Intrusion Detection System Module (WS-X6381-IDS).

The Intrusion Detection System Module (IDSM) is part of the Cisco Secure Intrusion Detection System (Cisco Secure IDS) and is managed by the Cisco Secure Policy Manager (Cisco Secure PM). (See Figure 9-1.) Cisco Secure PM provides a graphical interface for the management of security across a distributed network. The Intrusion Detection System Module performs network sensing, which involves real-time monitoring of network packets: packet capture and analysis.

Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

The Intrusion Detection System Module captures network packets, and then reassembles and compares this data against a set of rules that indicates typical intrusion activity. Network traffic is copied either to the Intrusion Detection System Module based on security VLAN access control lists (VACLs) in the switch or is routed to the Intrusion Detection System Module using the switch’s Switched Port Analyzer (SPAN) port feature. Both methods allow user-specified types of traffic that are based on switch ports, VLANs, or traffic type to be inspected.

The Intrusion Detection System Module searches for patterns of misuse by examining either the data portion or the header portion of network packets. Content-based attacks come from the data portion, and context-based attacks come from the header portion.

When the Intrusion Detection System Module detects an attack, it generates an alarm. Alarms are generated by the Intrusion Detection System Module through the Cisco 7600 series router backplane to the Cisco Secure PM, where they are logged or displayed on a graphical user interface. Alarm communication is handled by the Cisco Secure IDS Communication service protocol, a proprietary protocol that transmits alarms from the Intrusion Detection System Module to the Cisco Secure PM.

The front panel has a STATUS LED, a hard drive LED, a SHUTDOWN button, and a PCMCIA slot as shown in Figure 9-1.

Figure 9-1  Intrusion Detection System Module (WS-X6381-IDS)
Table 9-1 describes the Intrusion Detection System Module states as indicated by the STATUS LED.

<table>
<thead>
<tr>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>All diagnostics test pass. The module is operational.</td>
</tr>
<tr>
<td>Red</td>
<td>A diagnostic other than an individual port test failed.</td>
</tr>
<tr>
<td>Amber</td>
<td>The module is running through its boot and self-test diagnostics sequence.</td>
</tr>
<tr>
<td></td>
<td>The IDSM is disabled.</td>
</tr>
<tr>
<td>Off</td>
<td>The IDSM power is off.</td>
</tr>
</tbody>
</table>

The SHUTDOWN button manually shuts down the Intrusion Detection System Module. To prevent corruption of the module, it is critical that you shut down the module properly. To properly shut down the switching module, session into the Intrusion Detection System Module from the Cisco 7600 series router console and enter the `shutdown` command. If the Intrusion Detection System Module fails to respond to the `shutdown` command, press the SHUTDOWN button to manually shut down the Intrusion Detection System Module.

**Caution**

Do not remove the Intrusion Detection System Module from the switch until after the module shuts down completely. Removing the module without going through a shutdown procedure can damage the module.

Use a small pointed object, such as a paper clip, to access the SHUTDOWN button and turn off the Intrusion Detection System Module. The shutdown procedure may take several minutes.

The HD (hard drive) activity LED indicates when the hard drive is in use.

The PCMCIA slot provides access for up to two standard PCMCIA cards and is reserved for future use.
Content Switching Module

This chapter describes the Content Switching Module (WS-X6066-SLB-APC).

The Content Switching Module provides high-performance sessions between network devices and a server farm (a group of network servers) based on Layer 4 through Layer 7 information packets. (See Figure 10-1.) The module allows you to represent a group of servers (real servers) as a single-server instance (virtual server), balance the traffic to the servers, and limit traffic to individual servers.

Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

Figure 10-1  Content Switching Module (WS-X6066-SLB-APC)

The STATUS LED displays the Content Switching Module status as described in Table 10-1.

Table 10-1  Content Switching Module STATUS LED

<table>
<thead>
<tr>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>All diagnostic tests pass. The module is operational.</td>
</tr>
<tr>
<td>Orange</td>
<td>The module is running through its boot and self-test diagnostics sequence, or the module is disabled.</td>
</tr>
<tr>
<td>Red</td>
<td>A diagnostic test has failed.</td>
</tr>
<tr>
<td>Off</td>
<td>The module is powered down.</td>
</tr>
</tbody>
</table>
Switch Fabric Modules

This chapter describes the Switch Fabric Modules and includes the following sections:

- **Switch Fabric Module (WS-C6500-SFM), page 11-1**
- **Switch Fabric Module 2 (WS-X6500-SFM2), page 11-2**

**Note**

You can have a Switch Fabric Module (WS-C6500-SFM) with a Switch Fabric Module 2 (WS-X6500-SFM2) in the same Cisco 7606, Cisco 7609, or OSR-7609 chassis.

Switch Fabric Modules operate only with a Supervisor Engine 2. They are not supported with Supervisor Engine 1A or Supervisor Engine 720.

**Switch Fabric Module (WS-C6500-SFM)**

The Switch Fabric Module (WS-C6500-SFM) requires a Supervisor Engine 2 and must be installed in slot 5 or slot 6 of the Cisco 7606, Cisco 7609, or OSR-7609 routers. (See **Figure 11-1**.) The Switch Fabric Module cannot be installed in the Cisco 7613 switch or the Cisco 7603 router.

For redundancy, you can install a second Switch Fabric Module. The first-installed Switch Fabric Module functions as the primary module. When you install two modules at the same time, the module in slot 5 functions as the primary module, and the module installed in slot 6 functions as the backup. If you reset the Switch Fabric Module installed in slot 5, the module in slot 6 becomes the primary.

**Figure 11-1  Switch Fabric Module (WS-C6500-SFM)**

Two front-panel LEDs provide status information for the module and indicate whether the module is active. The STATUS LED functions are listed in Table 7-1 on page 7-2. The ACTIVE LED is green when the Switch Fabric Module is operational and active and is orange when the module is in standby mode.
The front panel on the Switch Fabric Module has a 2-line by 20-character LCD display. The display allows you to monitor the module’s input/output port traffic and local bus traffic. The display also shows system information.

Two push button switches control the LCD display:
- SELECT—This switch is used for LCD display menu selection.
- NEXT—This switch is used to scroll to the next item on the LCD display menu.

**Switch Fabric Module 2 (WS-X6500-SFM2)**

The Switch Fabric Module 2 (WS-X6500-SFM2) can be installed in any Cisco 7600 series router. (See Figure 11-2.) The Switch Fabric Module 2 requires Supervisor Engine 2 and must be installed in slot 5 or slot 6 of the Cisco 7606, Cisco 7609, or OSR-7609 routers, or in slot 7 or slot 8 of the Cisco 7613 router.

**Note**
The Switch Fabric 2 module cannot be installed in the Cisco 7603 router.

For redundancy, you can install a second Switch Fabric Module 2. The first-installed Switch Fabric Module 2 functions as the primary module. When you install two modules at the same time, the module in slot 5 or slot 7 functions as the primary module, and the module installed in slot 6 or slot 8 functions as the standby. If you reset the Switch Fabric Module 2 installed in slot 5 or slot 7, the module in slot 6 or slot 8 becomes the primary.

**Figure 11-2  Switch Fabric Module 2 (WS-X6500-SFM2)**

Two front-panel LEDs provide status information for the module and indicate whether the module is active. The STATUS LED functions are listed in Table 7-1 on page 7-2. The ACTIVE LED is green when the Switch Fabric Module is operational and active and is orange when the module is in standby mode.

The front panel of the Switch Fabric Module 2 has a 2-line by 20-character LCD display. The display allows you to monitor the module’s input/output port traffic and local bus traffic. The display also shows system information.

Two push button switches control the LCD display:
- SELECT—This switch is used for LCD display menu selection.
- NEXT—This switch is used to scroll to the next item on the LCD display menu.
Voice-Related Modules

This chapter describes the Voice-Related Modules and contains the following sections:

- Communications Media Module (WS-SVC-CMM), page 12-1
- 8-Port T1/E1 PSTN Interface Module (WS-X6608-T1/E1), page 12-4
- 24-Port FXS Analog Interface Module (WS-X6624-FXS), page 12-6

Note: Specific combinations of supervisor engines and modules may not be supported in your chassis. Refer to the release notes of the software version running on your system for specific information on modules and supervisor engine combinations that are not supported.

Communications Media Module (WS-SVC-CMM)

The Cisco 7600 series routers Communications Media Module can support single or multiple Cisco CallManagers in a voice-over-IP network. (See Figure 12-1.) The Communications Media Module, which acts as the media gateway, uses the Media Gateway Control Protocol (MGCP) to communicate with Cisco CallManager, which acts as the media gateway controller (Call Agent).

You can install up to three interface modules into the base module of the Communications Media Module. The Communications Media Module accepts either a 6-port T1 interface module or a 6-port E1 interface module. You must use the same types of interface modules (either all T1 modules or all E1 modules) in the Communications Media Module; you cannot mix the interface module types.

The 6-port T1/E1 interface modules have onboard digital signal processor (DSP) resources that allow you to connect the interfaces to the public switched telephone network (PSTN) or private branch exchanges (PBXs) through T1 Channel Associated Signaling (CAS) or T1/E1 ISDN Primary Rate Interface (PRI). The DSP resources on the interface modules provide echo cancellation, transcoding, fax relay, tone detection and generation, and jitter buffers.

The Communications Media Module provides Layer 2 forwarding only. If a packet needs to be Layer 3 routed, it is forwarded to the default gateway.

The Communications Media Module has a Gigabit Ethernet backplane interface that can have one IP address and one MAC address.

Note: The Communications Media Module requires a static IP address. Obtaining an IP address through a DHCP server is not supported. You assign an IP address to the Communications Media Module Gigabit Ethernet backplane interface through the CLI using the `interface GigabitEthernet1/0` command.
Table 12-1 lists the supported features for the Communications Media Module interface modules.

### Table 12-1  CMM Interface Module Supported Features

<table>
<thead>
<tr>
<th>WS-SVC-CMM-6T1 Module</th>
<th>WS-SVC-CMM-6E1 Module</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Line code</strong>—B8ZS(^1), AMI(^2)</td>
<td><strong>Line code</strong>—HDB3(^3), AMI</td>
</tr>
<tr>
<td><strong>Frame format</strong>—SF(^4), ESF(^5) with CRC(^6)/no CRC</td>
<td><strong>Frame format</strong>—with CRC4/no CRC4</td>
</tr>
<tr>
<td><strong>MGCP</strong></td>
<td><strong>MGCP</strong></td>
</tr>
<tr>
<td>T1-PRI</td>
<td>E1-PRI</td>
</tr>
<tr>
<td>T1-CAS E&amp;M(^7) Wink Start</td>
<td>Fax Pass-through</td>
</tr>
<tr>
<td>T1-CAS E&amp;M Delay Dial</td>
<td>Cisco Fax Relay</td>
</tr>
<tr>
<td>Fax Pass-through</td>
<td>DTMF Relay</td>
</tr>
<tr>
<td>Cisco Fax Relay</td>
<td>Modem Pass-through</td>
</tr>
<tr>
<td>Modem Pass-through</td>
<td>Music on Hold</td>
</tr>
<tr>
<td>Music on Hold</td>
<td>G711 codec (sampling size: 10, 20, and 30 ms)</td>
</tr>
<tr>
<td>DTMF(^8) Relay</td>
<td>G729 codec (sampling size: 10, 20, 30, 40, 50, and 60 ms)</td>
</tr>
<tr>
<td>G711 codec (sampling size: 10, 20, and 30 ms)</td>
<td></td>
</tr>
<tr>
<td>G729 codec (sampling size: 10, 20, 30, 40, 50, and 60 ms)</td>
<td></td>
</tr>
</tbody>
</table>

1. B8ZS = binary 8-zero substitution
2. AMI = alternate mark inversion
3. HDB3 = high-density bipolar with three zeros
4. SF = super framing
5. ESF = extended super framing
6. CRC = cyclic redundancy check
7. E&M = ear and mouth
8. DTMF = Dual Tone Multi-Frequency
9. DTMF is supported; DTMF/MF is not supported

For additional information, refer to the Catalyst 6500 Series and Cisco 7600 Series Communication Media Module Installation and Verification Note.

The front panel LEDs are described in Table 12-2.
### Table 12-2  CMM STATUS LED

<table>
<thead>
<tr>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
</table>
| Off         | - The module is waiting for the supervisor engine to turn on power.  
- The module is not online.  
- The module is not receiving power, which could be caused by the following:  
  - Power is not available to the module.  
  - Module temperature is over the limit\(^1\). |
| Red         | - The module is released from reset by the supervisor engine and is booting.  
- If the boot code fails to execute, the LED stays red after power up. |
| Orange      | - The module is initializing hardware or communicating with the supervisor engine.  
- A fault occurred during the initialization sequence.  
- If the module fails to download its Field Programmable Gate Arrays (FPGAs) on power up, it continues initializing and is granted module online status from the supervisor engine, but the LED stays orange.  
- If the module is not granted module online status from the supervisor engine, the LED stays orange. This problem could be caused by the supervisor engine detecting a failure in an external loopback test that it issued to the module. |
| Green       | - The module is operational; the supervisor engine has granted module online status. |

\(^1\) Enter the `show environment temperature mod` command to display the temperature of each of four sensors on the module.
Figure 12-2 and Figure 12-3 show the front panels of the 6-port T1 and E1 interface modules.

**Figure 12-2  6-Port T1 Interface Module**

The front panel LEDs are described in Table 12-3.

**Table 12-3  6-Port T1 and E1 Interface Modules Receive Port LEDs**

<table>
<thead>
<tr>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>T1/E1 interface is operational.</td>
</tr>
<tr>
<td>Red</td>
<td>T1/E1 receive alarm.</td>
</tr>
<tr>
<td>Yellow</td>
<td>T1/E1 remote alarm.</td>
</tr>
<tr>
<td>Off</td>
<td>The administrative port shut down or there is no power.</td>
</tr>
</tbody>
</table>

**8-Port T1/E1 PSTN Interface Module (WS-X6608-T1/E1)**

The 8-port T1/E1 PSTN interface module (WS-X6608-T1/E1) is a high-density, 8-port T1/E1 voice-over-IP (VoIP) module that can support digital T1/E1 connectivity to the Public Switched Telephone Network (PSTN) or transcoding and conferencing. (See Figure 12-4.) The module requires an IP address, is registered with Cisco CallManager in its domain, and is managed by Cisco CallManager.

The module software is downloaded from a TFTP server. Depending upon which software you download, the ports can serve as T1/E1 interfaces or support transcoding and conferencing as follows:

- Transcoding for IP-to-IP connections support the following:
  - 128 channels of full-duplex transcoding per module, 16 channels per port, if transcoding is between G.711 and a low bit-rate codec (such as the G.723.1).
- 64 channels of full-duplex transcoding per module, 8 channels per port, if transcoding is from a low bit-rate codec to a low bit-rate codec (such as from G723.1 to G.729).
- G.711, G.723.1, and the G.729A codecs in any combination.

- Conferencing supports the following:
  - Meet-Me and ad-hoc conferencing.
  - 32 channels of conferencing ports, 4 conferencings per port. The maximum conference size on a single port is 16 parties; 6 parties at a time can be active (talking) while the rest are idle (listening).
  - Transcoding and conferencing functions; for every transcoding port in use, one less conferencing port is available and vice versa.

**Note**
To configure the module interfaces, refer to the “Configuring a VoIP Network” chapter of the *Catalyst 6500 Series Switch Software Configuration Guide*. To configure the interfaces to work with Cisco CallManager, refer to the *Cisco CallManager Administration Guide*.

When the 8-port T1/E1 PSTN interface module powers up, it initializes various hardware components and communicates with the supervisor engine.

The front panel LEDs are shown in *Figure 12-4*.

*Figure 12-4 8-Port T1/E1 PSTN Interface Module (WS-X6608-T1/E1)*

The front panel LED operation is described in *Table 12-4*.

*Table 12-4 8-Port PSTN Interface Module LEDs*

<table>
<thead>
<tr>
<th>LED</th>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>Green</td>
<td>The module is operational. The supervisor engine has granted the module online status.</td>
</tr>
<tr>
<td></td>
<td>Orange</td>
<td>The module is booting or running diagnostics. The supervisor engine has disabled the module.</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>The module is resetting. (The switch has just been powered on or the module has been hot inserted.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The module processor detected a fatal error during its diagnostics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.)</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>The module is not receiving power. The module was powered down due to lack of power. (The module is listed as <em>power-deny</em> in the <em>show module</em> status field.)</td>
</tr>
</tbody>
</table>
The 24-port FXS analog interface module (WS-X6624-FXS) interfaces connect directly to standard analog telephones or fax machines. The module interfaces supply ring voltage and dial tone. The module emulates the central office (CO) or private branch exchange (PBX), providing a service to an analog telephone or fax machine. The telephone or fax machine connected through the FXS module operates as if it were connected to a normal CO or PBX line.

The front panel LEDs are shown in Figure 12-5.

### Table 12-4 8-Port PSTN Interface Module LEDs (continued)

<table>
<thead>
<tr>
<th>LED</th>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINK</td>
<td>Green</td>
<td>The link is up.</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>Frame synchronization has been lost or an RAI signal has been received.</td>
</tr>
<tr>
<td></td>
<td>Flashing</td>
<td>The SPAN is in loopback.</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>The SPAN is in loopback.</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>No carrier is detected or an AIS signal has been received.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>The registration with Cisco CallManager is lost.</td>
</tr>
</tbody>
</table>

### 24-Port FXS Analog Interface Module (WS-X6624-FXS)

The 24-port FXS analog interface module (WS-X6624-FXS) interfaces connect directly to standard analog telephones or fax machines. The module interfaces supply ring voltage and dial tone. The module emulates the central office (CO) or private branch exchange (PBX), providing a service to an analog telephone or fax machine. The telephone or fax machine connected through the FXS module operates as if it were connected to a normal CO or PBX line.

The front panel LEDs are shown in Figure 12-5.

---

**Warning**

If the symbol of suitability with an overlaid cross appears above a port, you must not connect the port to a public network that follows the European Union standards. Connecting the port to this type of public network can cause severe personal injury or can damage the unit. Statement 1031

---

**Note**

When installing the WS-X6624-FXS analog interface module in a chassis, you must have a system ground cable attached to the chassis. Refer to the c7600 Series Installation Guide for the system grounding cable installation procedure.

---

**Figure 12-5 24-Port FXS Analog Interface Module (WS-X6624-FXS)**

When the 24-port FXS analog interface module is powered up, it initializes various hardware components and communicates with the supervisor engine.

The front panel LEDs are described in Table 12-5.
### Table 12-5 24-Port FXS Analog Interface Module LEDs

<table>
<thead>
<tr>
<th>LED</th>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>Green</td>
<td>The module is online and operational.</td>
</tr>
<tr>
<td></td>
<td>Orange</td>
<td>The module is booting or running diagnostics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The supervisor engine has disabled the module.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The supervisor engine has sent an “SCP_SET_DIAG_FEATURES” message indicating that the diagnostics have failed.</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The module processor powered up but is not running.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The module processor detected a fatal error during its diagnostics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.)</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>The module is not receiving power. The module was powered down due to insufficient power. (The module is listed as power-deny in the show module status field.)</td>
</tr>
<tr>
<td>Port number</td>
<td>Green</td>
<td>The telephone or fax machine is off-hook.</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>The module or port is disabled through the CLI(^1).</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>The port is not active (connected device is on-hook) or the link is not connected.</td>
</tr>
</tbody>
</table>

---

1. CLI = command-line interface
Cisco 7600 Series Ethernet Services 20G Line Cards

This chapter describes the Cisco 7600 Series Ethernet Services 20G (ES20) line cards. It contains the following sections:

- Cisco 7600 Series Ethernet Services 20G Line Cards, page 13-1
- Cisco 7600-ES20-10G Line Card LEDs, page 13-1
- Cisco 7600-ES20-GE Line Card LEDs, page 13-2

Cisco 7600 Series Ethernet Services 20G Line Cards

The Cisco 7600 Series Ethernet Services 20G (ES20) line cards are a multiple-fabric, fixed-port Ethernet line card for the Cisco 7600 series routers that are capable of 20 Gbps of traffic forwarding using a fixed port interface design. The two versions of the Cisco 7600 Series Ethernet Services 20G line card are:

- 2-port version: 7600-ES20-10G
- 20-port version: 7600-ES20-GE

The difference between the two versions are the link interface daughter cards that accept small form-factor pluggable (SFP or XFP) optical transceivers. Additionally, each of the two versions has a packet engine daughter card and a control processor daughter card.

The SFP and XFP modules allow the line cards to be configured for different media types (copper or fiber) and different optical requirements (single mode fiber or multimode fiber) as available.

The 7600-ES20-10G uses a 2-port 10GE fixed interface daughter card that accepts pluggable XFP modules. The 7600-ES20-GE uses a 20-port GE fixed interface daughter card that accepts pluggable SFP modules.

For information on configuring features supported on the ES20 line cards, refer to the Cisco 7600-ES20 Ethernet Line Cards Configuration Guide. For information on installing the ES20 line cards, see the Cisco 7600-ES20 Ethernet Line Cards Hardware Installation Guide.

Cisco 7600-ES20-10G Line Card LEDs

The Cisco7600-ES20-10G line card has three LEDs, as shown in Figure 13-1. There is one Status LED and two A/L (Active Loopback) LEDs. Table 13-1 provides LED descriptions.
Figure 13-1  Cisco 7600-ES20-10G Faceplate

There is one line card Status LED and two port Status LEDs. Table 13-1 provides LED descriptions.

<table>
<thead>
<tr>
<th>LED Label</th>
<th>Color</th>
<th>State</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>Red</td>
<td>On</td>
<td>The line card has encountered an error.</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>On</td>
<td>The line card is online.</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>On</td>
<td>The line card is loading.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>Off</td>
<td>The line card is powered off.</td>
</tr>
<tr>
<td>A/L</td>
<td>Amber</td>
<td>On</td>
<td>The port is enabled but there is not a valid Ethernet link.</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>On</td>
<td>The port is enabled and a valid Ethernet link has been established.</td>
</tr>
<tr>
<td></td>
<td>Green and Amber</td>
<td>On</td>
<td>Undefined condition.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>Off</td>
<td>The port is not enabled by software.</td>
</tr>
</tbody>
</table>

Table 13-1  Cisco 7600-ES20-10G LEDs

Cisco 7600-ES20-GE Line Card LEDs

The Cisco 7600-ES20-GE line card has 21 LEDs, as shown in Figure 13-2.

Figure 13-2  Cisco 7600-ES20-GE Line Card Faceplate

There is one line card STATUS LED and twenty A/L (Active Loopback) LEDs. Table 13-2 provides LED descriptions.

<table>
<thead>
<tr>
<th>LED Label</th>
<th>Color</th>
<th>State</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>Red</td>
<td>On</td>
<td>The line card has encountered an error.</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>On</td>
<td>The line card is online.</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>On</td>
<td>The line card is loading.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>Off</td>
<td>The line card is powered off.</td>
</tr>
</tbody>
</table>
### Table 13-2  Cisco 7600-ES20-GE Line Card LEDs (continued)

<table>
<thead>
<tr>
<th>LED Label</th>
<th>Color</th>
<th>State</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/L</td>
<td>Amber</td>
<td>On</td>
<td>The port is enabled but there is not a valid Ethernet link.</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>On</td>
<td>The port is enabled and a valid Ethernet link has been established.</td>
</tr>
<tr>
<td></td>
<td>Green and Amber</td>
<td>On</td>
<td>Undefined condition.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>Off</td>
<td>The port is not enabled by software.</td>
</tr>
</tbody>
</table>
This chapter describes the Cisco Application Control Engine (ACE) module (ACE10-6500-K9). The ACE performs high-performance server load balancing (SLB) among groups of servers, server farms, firewalls, and other network devices, based on Layer 3 as well as Layer 4 through Layer 7 packet information. The ACE can also terminate and initiate SSL-encrypted traffic which allows the ACE to perform intelligent load balancing while ensuring secure end-to-end encryption. The module is capable of internetworking speeds of 4 Gigabits per second (Gbps) by default, and can achieve speeds of 8 Gbps with the purchase of an upgrade license.

Figure 14-1  Application Control Engine (ACE) module (ACE10-6500-K9)

The STATUS LED displays the Content Switching Module status as described in Table 14-1.
Table 14-1 Content Switching Module STATUS LED

<table>
<thead>
<tr>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>• The module is operational; the supervisor engine has provided module online status.</td>
</tr>
<tr>
<td>Orange</td>
<td>• The module is initializing hardware or communicating with the supervisor engine.</td>
</tr>
<tr>
<td></td>
<td>• A fault occurred during the initialization sequence.</td>
</tr>
<tr>
<td></td>
<td>• The module failed to download its Field Programmable Gate Arrays (FPGAs) at startup. The module continues with the remainder of the initialization sequence and provides the module online status from the supervisor engine.</td>
</tr>
<tr>
<td></td>
<td>• The module has not received module online status from the supervisor engine. This problem may be caused by the supervisor engine detecting a failure in an external loopback test that it issued to the module.</td>
</tr>
<tr>
<td>Green to Orange</td>
<td>• The module is disabled through the supervisor engine command line interface (CLI) using the no power enable module command.</td>
</tr>
<tr>
<td>Red</td>
<td>• The module is released from reset by the supervisor engine and is booting.</td>
</tr>
<tr>
<td></td>
<td>• The boot code failed to run.</td>
</tr>
<tr>
<td>Off</td>
<td>The module is waiting for the supervisor engine to provide power.</td>
</tr>
<tr>
<td></td>
<td>• The module is offline.</td>
</tr>
<tr>
<td></td>
<td>• The module is not receiving power, which may be caused by one of the following:</td>
</tr>
<tr>
<td></td>
<td>– Power is not available to the module.</td>
</tr>
<tr>
<td></td>
<td>– Module temperature is over the limit.</td>
</tr>
</tbody>
</table>
Cisco 7600 Ethernet Services Plus Line Cards

This chapter describes the Cisco 7600 Ethernet Services Plus (ES+) line cards. It contains the following sections:

- Cisco 7600 Ethernet Services Plus Line Cards, page 15-1
- Cisco 7600 ES+ 2TG3C, -3CXL Line Card LEDs, page 15-2
- Cisco 7600 ES+ 4TG3C, -4TG3CXL Line Card LEDs, page 15-3
- Cisco 7600 ES+ 20G3C, -20G3CXL Line Card LEDs, page 15-3
- Cisco 7600 ES+ 40G3C, -40G3CXL Line Card LEDs, page 15-4

Cisco 7600 Ethernet Services Plus Line Cards

The Cisco 7600 Series ES+ line cards are a multiple-fabric, fixed-port Ethernet line card for the Cisco 7600 series routers that are capable of 40 Gbps full-duplex traffic forwarding using a fixed port interface design. The Cisco 7600 Series ES+ line card versions are:

- 40-port version: 7600-ES+40G3C
- 40-port version: 7600-ES+40G3CXL
- 20-port version: 7600-ES+20G3C
- 20-port version: 7600-ES+20G3CXL
- 4-port version: 7600-ES+4TG3C
- 4-port version: 7600-ES+4TG3CXL
- 2-port version: 7600-ES+2TG3C
- 2-port version: 7600-ES+2TG3CXL

The difference between the versions are the link interface daughter cards that accept small form-factor pluggable (SFP or XFP\(^1\)) optical transceivers. Additionally, each of the versions has a common baseboard card and a control processor daughter card.

The SFP and XFP modules allow the line cards to be configured for different media types (copper or fiber) and different optical requirements (single mode fiber or multimode fiber) as available.

---

1. SFP modules are optics modules with speeds lower than 10 Gbps; XFP modules are optics modules with speeds equal to or greater than 10 Gbps.
Cisco 7600 ES+ 2TG3C, -3CXL Line Card LEDs

The Cisco 7600 ES+ 2TG3C, -3CXL line cards have three LEDs, as shown in Figure 15-1 and Figure 15-2. There is one Status LED and two A/L (Active Loopback) LEDs. Table 15-1 provides LED descriptions.

**Table 15-1 Cisco 7600 ES+ 2TG3C, -3CXL LEDs**

<table>
<thead>
<tr>
<th>LED Label</th>
<th>Color</th>
<th>State</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>Red</td>
<td>On</td>
<td>The line card has encountered an error.</td>
</tr>
<tr>
<td>Green</td>
<td>On</td>
<td></td>
<td>The line card is online.</td>
</tr>
<tr>
<td>Yellow</td>
<td>On</td>
<td></td>
<td>The line card is loading.</td>
</tr>
<tr>
<td>Off</td>
<td>Off</td>
<td></td>
<td>The line card is powered off.</td>
</tr>
<tr>
<td>A/L</td>
<td>Amber</td>
<td>On</td>
<td>The port is enabled but there is not a valid Ethernet link.</td>
</tr>
<tr>
<td>Green</td>
<td>On</td>
<td></td>
<td>The port is enabled and a valid Ethernet link has been established.</td>
</tr>
<tr>
<td>Green and Amber</td>
<td>On</td>
<td></td>
<td>Undefined condition.</td>
</tr>
<tr>
<td>Off</td>
<td>Off</td>
<td></td>
<td>The port is not enabled by software.</td>
</tr>
</tbody>
</table>
Cisco 7600 ES+ 4TG3C, -4TG3CXL Line Card LEDs

The Cisco 7600-ES+ 4TG3C, -4TG3CXL line cards have three LEDs, as shown in Figure 15-3 and Figure 15-4. There is one Status LED and two A/L (Active Loopback) LEDs. Table 15-2 provides LED descriptions.

![Figure 15-3 Cisco 7600 ES+ 4TG3C Faceplate](image)

![Figure 15-4 Cisco 7600 ES+ 4TG3CXL Faceplate](image)

There is one line card Status LED and two port Status LEDs. Table 15-1 provides LED descriptions.

<table>
<thead>
<tr>
<th>LED Label</th>
<th>Color</th>
<th>State</th>
<th>Meaning</th>
<th>Color</th>
<th>State</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>Red</td>
<td>On</td>
<td>The line card has encountered an error.</td>
<td>Green</td>
<td>On</td>
<td>The line card is online.</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>On</td>
<td>The line card is online.</td>
<td>Yellow</td>
<td>On</td>
<td>The line card is loading.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>Off</td>
<td>The line card is powered off.</td>
<td>Green and Amber</td>
<td>On</td>
<td>Undefined condition.</td>
</tr>
<tr>
<td>A/L</td>
<td>Amber</td>
<td>On</td>
<td>The port is enabled but there is not a valid Ethernet link.</td>
<td>Off</td>
<td>Off</td>
<td>The port is not enabled by software.</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>On</td>
<td>The port is enabled and a valid Ethernet link has been established.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cisco 7600 ES+ 20G3C, -20G3CXL Line Card LEDs

The Cisco 7600 ES+ 20G3C, -20G3CXL line cards have 21 LEDs, as shown in Figure 15-5 and Figure 15-6.
There is one line card STATUS LED and twenty A/L (Active Loopback) LEDs. Table 15-3 provides LED descriptions.

**Table 15-3  Cisco 7600 ES+ 20G3C, -20G3CXL Line Card LEDs**

<table>
<thead>
<tr>
<th>LED Label</th>
<th>Color</th>
<th>State</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>Red</td>
<td>On</td>
<td>The line card has encountered an error.</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>On</td>
<td>The line card is online.</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>On</td>
<td>The line card is loading.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>Off</td>
<td>The line card is powered off.</td>
</tr>
<tr>
<td>A/L</td>
<td>Amber</td>
<td>On</td>
<td>The port is enabled but there is not a valid Ethernet link.</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>On</td>
<td>The port is enabled and a valid Ethernet link has been established.</td>
</tr>
<tr>
<td></td>
<td>Green and Amber</td>
<td>On</td>
<td>Undefined condition.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>Off</td>
<td>The port is not enabled by software.</td>
</tr>
</tbody>
</table>

**Cisco 7600 ES+ 40G3C, -40G3CXL Line Card LEDs**

The Cisco 7600 ES+ 40G3C, -40G3CXL line cards have 21 LEDs, as shown in Figure 15-7 and Figure 15-8.
There is one line card STATUS LED and twenty A/L (Active Loopback) LEDs. Table 15-4 provides LED descriptions.

<table>
<thead>
<tr>
<th>LED Label</th>
<th>Color</th>
<th>State</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS</td>
<td>Red</td>
<td>On</td>
<td>The line card has encountered an error.</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>On</td>
<td>The line card is online.</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>On</td>
<td>The line card is loading.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>Off</td>
<td>The line card is powered off.</td>
</tr>
<tr>
<td>A/L</td>
<td>Amber</td>
<td>On</td>
<td>The port is enabled but there is not a valid Ethernet link.</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>On</td>
<td>The port is enabled and a valid Ethernet link has been established.</td>
</tr>
<tr>
<td></td>
<td>Green and Amber</td>
<td>On</td>
<td>Undefined condition.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>Off</td>
<td>The port is not enabled by software.</td>
</tr>
</tbody>
</table>
This chapter provides information about the firewall solution, Cisco Adaptive Security Appliance Services Module (ASA SM).

This chapter contains the following topics:

- Functional Overview of Firewalls
- ASA SM Overview
- ASA SM Front Panel LEDs
- ASA SM Support
- Deployment of ASA SM
- ASA SM Firewall Modes
- Security Context Overview
- ASA SM Failover Mechanism
- Support on Chassis
- Restrictions and Configuration
- Troubleshooting
- ASA SM Documentation

**Functional Overview of Firewalls**

Firewalls protect inside networks from unauthorized access by users on outside networks. A firewall can also protect inside networks from each other, for example, keeping a human resources network separate from a user network. If you want network resources to be made available to an outside user, such as a Web or FTP server, you can place these resources on a separate network behind the firewall, called a demilitarized zone (DMZ). The firewall allows limited access to the DMZ. As the DMZ only includes the public servers, an attack there only affects the servers and does not affect other inside networks. You can also control when inside users access outside networks (for example, the Internet), by allowing only certain addresses out, requiring authentication or authorization, or coordinating with an external URL filtering server.

When discussing networks connected to a firewall, the outside network is in front of the firewall, the inside network is protected and behind the firewall, and a DMZ, while behind the firewall, allows limited access to outside users. Because ASA SM lets you configure many interfaces with varied security policies, including many inside interfaces, many DMZs, and even many outside interfaces if desired, these terms are used in a general sense only.
ASA SM Overview

Cisco Adaptive Security Appliance Services Module (ASA SM) is a high-speed, integrated network security module for Cisco 7600 series routers. ASA SM works with c7600 line cards, and delivers high throughput, low latency, and high availability. ASA SM has more advanced features than the service module, Firewall Services Module (FWSM). Although not all FWSM features are available in ASA SM, ASA SM has bridge groups and mixed context mode support.

ASA SM does not have any external interfaces. The module includes logical interfaces within the router itself. The console port is virtual and accessible directly through the router.

ASA SM Front Panel LEDs

Figure 16-1 shows the ASA SM front panel LEDs, and Table 0-1 describes them.

![ASA Services Module (WSC-SVC-ASA-SM1-K9)](image)

Table 16-1 ASA SM STATUS LED Description

<table>
<thead>
<tr>
<th>Color/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>All diagnostic tests passed. The module is operational.</td>
</tr>
<tr>
<td>Red</td>
<td>A diagnostic test other than an individual port test failed.</td>
</tr>
<tr>
<td>Orange</td>
<td>Indicates one of the following conditions:</td>
</tr>
<tr>
<td></td>
<td>• The module is running through its boot and self-test diagnostic sequence.</td>
</tr>
<tr>
<td></td>
<td>• The module is disabled.</td>
</tr>
<tr>
<td></td>
<td>• The module is in the shutdown state.</td>
</tr>
<tr>
<td>Off</td>
<td>The power for the firewall module is off.</td>
</tr>
</tbody>
</table>

ASA SM Support

This section lists the support available for ASA SM, the features that ASA SM supports and the extent of the support.
Support for ASA SM

ASA SM is supported on the following:

- 7606-S and 7609-S chassis
- Supervisor Engine 720 3B/3BXL, Route Switch Processor 720-1GE, and Route Switch Processor 720-10GE

Support on ASA SM

ASA SM supports the following:

- The ‘Autostate’ feature which allows the ASA SM blade to quickly detect that an interface connected to a real host has failed
- Over two million firewall rules and 12 GB addressable memory
- Multicast features that include multicast routing protocols like PIM-SM and IGMP stubmode.
  The span reflector that was needed on the Firewall Services Module to pass multicast is no longer required.
- 250 virtual contexts and 1000 VLANs
- Network address translation (NAT) system and global access control lists (ACLs)
- ASA failover mechanism
  The mechanism supports the following: high-speed failover between modules within a single Cisco 7600 chassis and high-speed failover between modules in separate chassis.
- Online diagnostic tests for bootup and periodic health monitoring. Health monitoring tests run at intervals configured by the user. The default interval for tests is 15 seconds.

The tests include the following:

- Processor Complex (PC) Loopback Test checks the health of the two backplane ports which form the data-path on ASA SM.
- PC Device Status Test retrieves the status of the various hardware devices controlled by the processor complex.
- DataPort Loopback Test initiates a hardware loopback at the datapath field-programmable gate array (FPGA) level with the capability to loop back diagnostic packets on the basis of a VLAN match. This test verifies if the Receive-Side Scaling (RSS) hash algorithm worked over data packets, and identifies the exact drop location of the packet within the FPGA.
- Management Port Loopback Test initiates a software loopback of diagnostic packets from the inband port to test the health of the two management ports on the router service module. A special global VLAN reserved for the online diagnostic packets uniquely identifies the packet in the system. Run Software Loopback as a bootup, health monitoring, on-demand and scheduled diagnostic test.
Deployment of ASA SM

The ASA SM card can be deployed in 7606-S and 7609-S chassis. You can configure any physical port on the router to operate with firewall policy and protection. ASA SM is Network Equipment-Building System (NEBS) compliant. Slots adjacent to the ASA SM slot are either used or provided with ‘airdam’. Airdam is a blank panel that provides an air shield. Airdam cards in empty slots ensure correct air-flow around the cards.

You can deploy ASA SM in the following modes:

- In the homogeneous mode, only ASA SM resides in the 7600 chassis.
- In the coexistent mode, both ASA SM and FWSM reside in the same router chassis and network, or in the same network, but are managed by separate management tools.
- In the heterogeneous mode, both ASA SM and FWSM are deployed and in operation either in the same router chassis or in the same network, and are managed by the same management tool.

ASA SM Firewall Modes

ASA SM runs in the following firewall modes:

- Routed
- Transparent

Routed Mode

In the routed mode, ASA SM is considered to be a router hop in the network. It can use OSPF or RIP in the single context mode. Routed mode supports many interfaces. Each interface is on a different subnet. You can share interfaces between contexts. ASA SM acts as a router between the connected networks, and each interface requires an IP address on a different subnet. In the single context mode, the routed firewall supports Open Shortest Path First (OSPF), Enhanced Interior Gateway Routing Protocol (EIGRP), and Routing Information Protocol (RIP). Multiple context mode only supports static routes. We recommend using the advanced routing capabilities of the upstream and downstream routers instead of relying on ASA SM for extensive routing needs.

Transparent Mode

In the transparent mode, ASA SM is not considered a router hop, but acts like a “bump in the wire,” or a ‘stealth firewall’. ASA SM connects to the same network on its internal and external interfaces.

Use a transparent firewall for the following:

- Simplify your network configuration.
- Make the firewall invisible to attackers.
- Allow traffic that would be blocked in the routed mode. For example, a transparent firewall can allow multicast streams using an Ether Type access list.
Security Context Overview

You can partition a single ASA SM into multiple virtual devices, known as security contexts. Each context is an independent device, with its own security policy, interfaces, and administrators. Multiple contexts are equivalent to multiple standalone devices. Multiple context mode supports multiple features, routing tables, firewall features, IPS, and management. VPN and dynamic routing protocols are not supported.

In the multiple context mode, ASA SM includes a configuration for each context that identifies the security policy, interfaces, and most options you can configure on a standalone device. System administrators configure contexts to add and manage them in the system configuration.

The following are characteristics of the system configuration:

- Like a single mode configuration, the system configuration is the startup configuration.
- System configuration identifies the basic settings for ASA SM.
- System configuration does not include any network interfaces or network settings for itself. When the system needs to access network resources (such as downloading the contexts from the server), it uses one of the contexts that is designated as the administrator context. The administrator context is just like any other context. However, it gives the user who logs into the admin context system administrator rights to access the system and all other contexts.

ASA SM Failover Mechanism

Failover supports redundancy in ASA SMs. The failover mechanism helps you configure two ASA SMs. If an ASA SM fails, the redundant ASA SM starts functioning.

ASA SM supports two failover configurations:

- Active-Active failover
- Active-Standby failover

Active-Active failover

Active-Active failover is only available on units that run in the multiple context mode. In this failover, both units can pass network traffic. This failover lets you configure load balancing on your network.

Active-Standby failover

Active-Standby failover is available on units that run in either the single or multiple context mode. In this failover, one unit passes traffic while the other unit waits in a standby state.

Support on Chassis

ASA SM works with other modules in the router chassis to deliver robust security throughout the entire chassis, effectively making every port a security port. ASA SM and the Firewall Services Module can run simultaneously in the same chassis.
The number of ASA SMs supported on the chassis for centralized and distributed forwarding is as follows:

- Centralized Forwarding supports three ASA SM cards per chassis. Central forwarding has an ingress and an egress supervisor EARL lookup.
- Distributed Forwarding supports four ASA SM cards per chassis. In distributed forwarding, ingress lookup is done by the line-card, and egress lookup is done by the supervisor EARL.

**Restrictions and Configuration**

**Restrictions**

The following restrictions apply to ASA SM:

- ASA SM is only supported on the 7606-S and 7609-S chassis. Support for 7613-S and lead free version of 7606-S will become available later.
- ASA SM is not supported on Cisco 7603 and Cisco 7604 routers.

**ASA Configuration**

ASA SM uses one of the following multi-card configurations to scale bandwidth:

- VLAN-based approach: This approach uses multiple ASA SMs per chassis. Each ASA SM is assigned a distinct set of VLANs. Traffic is assigned to a specific ASA SM based on its incoming or outgoing VLAN tag.
- Policy-based routing approach: This approach is similar to the VLAN-based approach except that the supervisor uses a policy based routing (PBR) scheme based on the source of the traffic, application types, or destination to route packets across multiple ASA SM cards.

**Note**


**Troubleshooting**

<table>
<thead>
<tr>
<th>Command</th>
<th>Execution Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debug firewall</td>
<td>RP of Supervisor</td>
</tr>
<tr>
<td>Debug trifecta</td>
<td>SP of Supervisor</td>
</tr>
</tbody>
</table>
## Debug commands

### Requirement

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Debug Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>To detect the following:</td>
<td></td>
</tr>
<tr>
<td>• If SCP messages are dropped between the Supervisor SP or RP and the linecard</td>
<td>Use the <code>debug firewall</code> command.</td>
</tr>
<tr>
<td>• To check the SCP communication between the linecard and supervisor</td>
<td></td>
</tr>
<tr>
<td>• To check whether the firewall slot is up, about the VLAN bitlist, and firewall configuration events</td>
<td></td>
</tr>
<tr>
<td>• To check port channel IDB configurations for the firewall</td>
<td></td>
</tr>
<tr>
<td>• To investigate errors of the following kind:</td>
<td></td>
</tr>
<tr>
<td>errors in VLAN association, errors in port channel configurations of the firewall, SCP errors while initializing the packets, and invalid events</td>
<td></td>
</tr>
<tr>
<td>To detect errors that pertain to major or severe events in the firewall module processes</td>
<td>Use the <code>debug trifecta</code> command.</td>
</tr>
</tbody>
</table>

## ASA SM Documentation

Cisco ASA Series Documentation is available at:

ASA hardware and software compatibility information is available at:

ASA SM compatibility documentation is available at:

ASA SM hardware documentation is available at:

ASA SM quick start documentation is available at:

ASA SM New Features by Release is available at:
Technical Specifications

This appendix provides the technical specifications for the Cisco 7600 series routers modules.

Module Specifications

Table A-1 lists the environmental and physical specifications for the Cisco 7600 series routers modules.

Table A-1  Environmental and Physical Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature, ambient operating</td>
<td>32°F (0°C) to 104°F (40°C)</td>
</tr>
<tr>
<td>Temperature, ambient nonoperating and</td>
<td>–40°F (–40°C) to 167°F (75°C)</td>
</tr>
<tr>
<td>storage</td>
<td></td>
</tr>
<tr>
<td>Humidity (RH), ambient (noncondensing)</td>
<td>10% to 90%</td>
</tr>
<tr>
<td>operating</td>
<td></td>
</tr>
<tr>
<td>Altitude operating</td>
<td>–197 to 6500 ft (–60 to 2000 m)</td>
</tr>
<tr>
<td><strong>Physical Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Dimensions (H x W x D)</td>
<td>1.2 x 14.4 x 16 in (3.0 x 35.6 x 40.6 cm)</td>
</tr>
<tr>
<td>Weight</td>
<td>3 to 10 lb (1.4 to 4.5 kg)</td>
</tr>
</tbody>
</table>

Regulatory Standards Compliance

Cisco 7600 series routers modules comply with the regulatory standards listed in the Regulatory Compliance and Safety Information for the Cisco 7600 Series Routers publication.
Translated Safety Warnings

This appendix repeats in multiple languages the warnings in this guide. These translated warnings can be used with other documents related to this guide.

Safety Information Referral Warning

⚠️ Warning ⚠️

Before you install, operate, or service the system, read the Site Preparation and Safety Guide. This guide contains important safety information you should know before working with the system.

Waarschuwing

Lees de handleiding Voorbereiding en veiligheid van de locatie Handleiding voordat u het systeem installeert of gebruikt of voordat u onderhoud aan het systeem uitvoert. Deze handleiding bevat belangrijke beveiligingsvoorschriften waarvan u op de hoogte moet zijn voordat u met het systeem gaat werken.

Varoitus

Ennen kuin asennat järjestelmän tai käytät tai huollat sitä, lue Asennuspaikan valmistelu-jaturvaopas-opasta. Tässä oppaassa on tärkeitä turvallisuustietoja, jotka tulisi tietää ennen järjestelmän käyttämistä.

Attention

Avant d’installer le système, de l’utiliser ou d’assurer son entretien, veuillez lire le Guide de sécurité et de préparation du site. Celui-ci présente des informations importantes relatives à la sécurité, dont vous devriez prendre connaissance.

Warnung


Avvertenza

Prima di installare, mettere in funzione o effettuare interventi di manutenzione sul sistema, leggere le informazioni contenute nella documentazione sulla Guida alla sicurezza. Tale guida contiene importanti informazioni che è necessario acquisire prima di iniziare qualsiasi intervento sul sistema.
Wrist Strap Warning

**Warning**

During this procedure, wear grounding wrist straps to avoid ESD damage to the card. Do not directly touch the backplane with your hand or any metal tool, or you could shock yourself.

**Waarschuwing**

Draag tijdens deze procedure aardingspolsbanden om te vermijden dat de kaart beschadigd wordt door elektrostatische ontlading. Raak het achterbord niet rechtstreeks aan met uw hand of met een metalen werktuig, omdat u anders een elektrische schok zou kunnen oplopen.

**Varoitus**

Käytä tämän toimenpiteen aikana maadoitettuja rannesuojia estääksesi kortin vaarioitumisen sähköstösgattisen purkauksen vuoksi. Älä kosketa taustalevyä suoraan kädelläsi tai metallisella työkalulla sähköiskuvaaran takia.

**Attention**

Lors de cette procédure, toujours porter des bracelets antistatiques pour éviter que des décharges électriques n’endommagent la carte. Pour éviter l’électrocution, ne pas toucher le fond de panier directement avec la main ni avec un outil métallique.

**Warnung**

Blank Faceplate Installation Requirement Warning

**Warning**

Blank faceplates (filler panels) serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards and faceplates are in place.

**Waarschuwing**

Lege vlakplaten (vulpanelen) vervullen drie belangrijke functies: ze voorkomen blootstelling aan gevaarlijke voltages en elektrische stroom binnenin het chassis; ze beperken elektromagnetische storing hetgeen andere apparaten kan storen en ze leiden een stroom van koellucht door het chassis. Bedien het systeem niet tenzij alle kaarten en vlakplaten zich op hun plaats bevinden.

**Varoitus**

Tyhjillä kansilaatoilla (peitelevyillä) on kolme tehtävää: ne suojaavat vaarallisia asennuspohjan sisäisiltä jännitteiltä ja virrhoilta; suojaavat sähkömagneettiselta häiriöltä (EMI), joka voi haitata muiden laitteiden toimintaa; ja ohjaavat jäädytysilmavirran asennuspohjan läpi. Laitetta ei saa käyttää, jos kaikki kortit ja peitelevyt eivät ole paikoillaan.
Les caches blancs remplissent trois fonctions importantes : ils évitent tout risque de choc électrique à l’intérieur du châssis, ils font barrage aux interférences électromagnétiques susceptibles d’altérer le fonctionnement des autres équipements et ils dirigent le flux d’air de refroidissement dans le châssis. Il est vivement recommandé de vérifier que tous les caches et plaques de protection sont en place avant d’utiliser le système.

Unbeschriftete Aufspannplatten (Füllpaneelen) erfüllen drei wichtige Funktionen: sie schützen vor gefährlichen Spannungen und Elektrizität im Innern der Chassis; sie halten elektromagnetische Interferenzen (EMI) zurück, die andere Geräte stören könnten; und sie lenken die Kühl Luft durch das Chassis. Nehmen Sie das System nur in Betrieb, wenn alle Karten und Aufspannplatten an vorgesehener Stelle ordnungsgemäß installiert sind.

Le piastre di protezione (panelli di riempimento) hanno tre funzioni molto importanti: impediscono di esporvi ai voltaggi e le tensioni elettriche pericolose del chassis; trattengono le interferenze elettromagnetiche (EMI) che possono scombussolare altri apparati; e avviano il flusso d’aria di raffreddamento attraverso il chassis. Non operate il sistema se le schede e i panelli non sono in posizione.

Blanke ytterplater (deksler) har tre viktige funksjoner: De forhindrer utsettelse for farlig spenning og strøm inni kabinettet; de inneholder elektromagnetisk forstyrrelse (EMI) som kan avbryte annet utstyr, og de dirigerer luftavkjølingsstrømmen gjennom kabinettet. Betjen ikke systemet med mindre alle kort og ytterplater sitter på plass.

As placas em bruto (painéis de enchimento) desempenham três funções importantes: evitam a exposição a voltagens e correntes perigosas no interior do chassi; protegem de interferências electromagnéticas (EMI) passíveis de afeectar outro equipamento; e orientam o fluxo do ar de refrigeração através do chassi. Não pôr o sistema a funcionar sem que todos os cartões e placas estejam no devido lugar.

Los platos en blanco (paneles de relleno) ofrecen tres funciones importantes: previenen la exposición a voltajes peligrosos y corrientes dentro del chassi; contienen interferencias electromagnéticas (EMI) que pueden interrumpir otros equipos; y dirigen el flujo de aire refrigerante a través del chassi. No opere el sistema a menos que todas las tarjetas y placas estén en su lugar.
EU Public Network Port Warning

**Warning**
If the symbol of suitability with an overlaid cross appears above a port, you must not connect the port to a public network that follows the European Union standards. Connecting the port to this type of public network can cause severe injury or damage your router.

**Waarschuwing**
Als er een geschiktheidsymbool met een overgetrokken kruis boven een poort aanwezig is, dan mag u deze poort niet op een openbaar netwerk aansluiten dat aan de normen van de Europese Unie voldoet. Als u de poort op een dergelijk openbaar netwerk aansluit, kan dit ernstig letsel of schade aan uw router-eenheid veroorzaken.

**Varoitus**
Jos portin päälle ilmestyy soveltuvuussymboli, jonka päällä on rasti, porttia ei saa liittää Euroopan unionin standardien mukaiseen julkiseen verkkoon. Jos portti liitetään julkiseen verkkoon, seuraaksena voi olla henkilö- tai reititinvaario.

**Attention**
Pour éviter tout risque d'accident corporel et/ou de dommage matériel, si le symbole de capacité barré d’une croix apparaît au-dessus d’un port, il est vivement recommandé de ne pas connecter ce port à un réseau public aux normes de l'Union Européenne.

**Warnung**
Wenn oberhalb des Ports das Verträglichkeitssymbol mit einem Kreuz darüber erscheint, dürfen Sie den Port nicht an ein öffentliches Netzwerk anschließen, daß den Standards der Europäischen Gemeinschaft folgt. Das Anschließen des Port an ein solches Netzwerk kann zu schweren Verletzungen führen oder Ihren Router beschädigen.

**Avvertenza**
Se su una porta compare il simbolo di idoneità sbarrato, significa che la porta non può essere collegata a una rete pubblica a norma UE. Collegando la porta a un simile tipo di rete pubblica si possono correre seri rischi e provocare danni al proprio router.

**Advarsel**
Hvis symbolet for anvendelse med et kryss over vises over en utgang, skal utgangen ikke kobles til et offentlig nettverk som følger EU-standardene. Hvis utgangen kobles til denne typen offentlig nettverk, kan det medføre alvorlig personskade eller skade på ruteren.

**Aviso**
Se o símbolo de adequação com uma cruz sobreposta aparecer acima de uma porta, não conectar a porta a uma rede pública que obedece aos padrões da União Europeia. A conexão da porta a este tipo de rede pública pode causar avarias ou danos severos ao seu distribuidor.
Invisible Laser Radiation Warning

Warning Because invisible laser radiation may be emitted from the aperture of the port when no cable is connected, avoid exposure to laser radiation and do not stare into open apertures.

Waarschuwing Omdat er onzichtbare laserstraling uit de opening van de poort geëmitteerd kan worden wanneer er geen kabel aangesloten is, dient men om blootstelling aan laserstraling te vermijden niet in de open openingen te kijken.

Varnoitus Kun porttiin ei ole kytketty kaapelia, portin aukosta voi vuotaa näkymätöntä lasersäteilyä. Älä katso avoimiin aukoihin, jotta et altistu säteilylle.

Attention Etant donné qu’un rayonnement laser invisible peut être émis par l’ouverture du port quand aucun câble n’est connecté, ne pas regarder dans les ouvertures béantes afin d’éviter tout risque d’exposition au rayonnement laser.

Warnung Aus der Öffnung des Ports kann unsichtbare Laserstrahlung austreten, wenn kein Kabel angeschlossen ist. Kontakt mit Laserstrahlung vermeiden und nicht in offene Öffnungen blicken.

Avvertenza Poiché quando nessun cavo è collegato alla porta, da quest’ultima potrebbe essere emessa radiazione laser invisibile, evitare l’esposizione a tale radiazione e non fissare con gli occhi porte a cui non siano collegati cavi.

Advarsel Usynlige laserstråler kan sendes ut fra åpningen på utgangen når ingen kabel er tilkoblet. Unngå utsettelse for laserstråling og se ikke inn i åpninger som ikke er tildekket.

Aviso Evite uma exposição à radiação laser e não olhe através de aberturas expostas, porque poderá ocorrer emissão de radiação laser invisível a partir da abertura da porta, quando não estiver qualquer cabo conectado.
¡Advertencia! Cuando no esté conectado ningún cable, pueden emitirse radiaciones láser invisibles por el orificio del puerto. Evitar la exposición a radiaciones láser y no mirar fijamente los orificios abiertos.

Warning! Osynliga laserstrålar kan sändas ut från öppningen i porten när ingen kabel är ansluten. Undvik exponering för laserstrålning och titta inte in i ej täckta öppningar.
INDEX

Numerics

7600-ES20-10G line card
   LEDs 13-1

A

ACTIVE LED
   ATM modules description (table) 3-3
addresses
   MAC 1-3
   physical interface 1-2
   ports 1-2
Application Control Engine (ACE) module 14-1
ASA SM 16-2
ASA SM deployment 16-4
ASA SM firewall modes 16-4
ASA SM support 16-3
ATM
   LEDs 3-3
   modules 3-1 to 3-3
audience i-ix

B

blank faceplate installation requirement warning B-3

cables
   distance limitations
      description 1-4
channel capacity

connection distances and 1-4
commands
   show port 1-3
Communication Media Module
   E1 interface module front panel (figure) 12-4
   front panel (figure) 12-2
   interface modules features (table) 12-2
   LEDs (table) 12-3
   T1 interface module front panel (figure) 12-4

D

distance limitations
   connections 1-4
   description 1-4
document
   revision history i-ix

E

EEPROM 1-3
environmental monitoring 1-4
environmental specifications (table) A-1
ES+ line cards 15-1
- 7600-ES+20G3C 15-1
- 7600-ES+20G3CXL 15-1
- 7600-ES+2TG3C 15-1
- 7600-ES+2TGCXL 15-1
- 7600-ES+40G3C 15-1
- 7600-ES+40G3CXL 15-1
- 7600-ES+4TG3C 15-1
- 7600-ES+4TGCXL 15-1

Ethernet modules
- WS-6024-10FL-MT 2-18
- WS-X6148-GE-TX 2-18
- WS-X6148-RJ21V 2-19
- WS-X6148-RJ45V 2-20
- WS-X6148V-GE-TX 2-18
- WS-X6248-RJ45 2-21
- WS-X6548-GE-TX 2-25
- WS-X6548V-GE-TX 2-25

Ethernet Services 20G (ES20) line cards 13-1

F

failover 16-5
fiber-optic connectors 1-6
connectors 1-5
fiber-optic cable channel capacity 1-4

Firewall Services Module
features 7-1
front panel (figure) 7-2
LEDs (table) 7-2

FlexWAN and enhanced FlexWAN features 4-1
LED description 4-3
supported port adapters 4-1

FlexWAN modules
front panel (figure) 4-3
front panel features

G

GBICs
See also specific types of GBICs 1-7

Gigabit Ethernet modules 2-27
Gigabit Interface Converters 1-7

I

IEEE, recommended signaling requirements 1-4

Intrusion Detection System Module
description 9-1
front panel (figure) 9-1
hard disk LED 9-2
LEDs (table) 9-2
PCMCIA slot 9-2
shutdown button 9-2

L

LEDs 4-3, 13-1, 15-2, 15-3
ATM modules (table) 3-3
description 1-1
modules 2-35

LINK LED
ATM modules description (table) 3-3
description (table) 2-37
supervisor engine 1-2

LX/LH GBIC 1-5

M

MAC address
allocation 1-3
description 1-2
module functionality
Index

hot swapping 1-4
MAC address 1-2
MAC address allocation 1-3
physical interface addresses 1-2
port addresses 1-2
modules
  LED description 2-35
  supervisor engine module 1-3
MSM
  features 5-1
  front panel (figure) 5-2
  status LED 5-2
MT-RJ connectors
  100BASE-FX 1-5
Multilayer Switch Feature Card (MSFC) 4-1
Multilayer Switch Module
  See MSM

N
NAM
  features 6-1
Network Analysis Module
  See NAM

O
organization i-ix

P
PHONE LED
  WS-X6148-RJ21V 2-19
  WS-X6148-RJ45V 2-20
  WS-X6348-RJ-21V 2-23
  WS-X6348-RJ-45 2-23
  WS-X6348-RJ-45V 2-24

PHONE LED description (table) 2-37
physical interface addresses 1-2
physical specifications (table) A-1
Policy Feature Card (PFC) 4-1
port
  densities 1-6
  port adapters
    supported 4-1
  port addresses 1-2
  power management 1-4

R
related documentation i-xv
RJ-45 connector, 10/100BASE-TX 1-5
RX LED
  ATM modules description (table) 3-3

S
safety information referral warning B-1
SC-type connector
  GBIC interfaces 1-5
security context 16-5
show port command 1-3
SHUTDOWN button
  NAM front panel (figure) 6-4
signaling requirements, IEEE-recommended 1-4
SIGNAL LED
  ATM modules description (table) 3-3
software requirements 1-13
specifications, environmental and physical (table) A-1
STATUS LED 4-3, 5-2
  ATM module description (table) 3-3
  Ethernet and gigabit Ethernet module description (table) 2-35
  firewall service modules 7-2
  MSM module description (table) 5-2
  Supervisor Engine 1
STATUS LED  5-2
supervisor engine 1
  STATUS LED  4-3
supervisor engine module, slot numbers  1-3
Switch Fabric Modules
  features  11-1, 11-2
  front panel (figure)  11-1, 11-2
  LCD display  11-2
  STATUS LED  11-1, 11-2

interface module LEDs (table)  12-4
  LEDs (table)  12-3
  supported features (table)  12-2
WS-SVC-FWM-1-K9
  front panel (figure)  7-2
  LEDs  7-2
  LEDs (table)  7-2
  shutdown button  7-3
WS-SVC-IPSEC-1
  description  8-1
  front panel (figure)  8-1
  LEDs (table)  8-2
WS-SVC-NAM-1
  description  6-1
  front panel (figure)  6-2
  LEDs (table)  6-2
  shutdown button  6-2
  supported RMON groups  6-1
WS-SVC-NAM-2
  description  6-2
  front panel (figure)  6-3
  LEDs (table)  6-3
  RMON groups supported  6-3
WS-X6024-10FL-MT
  description  2-18
  front panel (figure)  2-18
  LEDs  2-18
WS-X6066-SLB-APC
  description  10-1
  front panel (figure)  10-1
  LEDs (table)  10-1, 14-2
WS-X6101-OC12-MMF
  console port mode switch  3-1
  description  3-1
  front panel (figure)  3-2
  LEDs  3-2
WS-X6101-OC12-SMF
  console port mode switch  3-2
  description  3-2
WS-X6148-GE-TX
  description 2-18
  front panel (figure) 2-18
  LEDs 2-18
WS-X6148-RJ21V
  description 2-19
  front panel (figure) 2-19
  inline power 2-19
  LEDs 2-19
WS-X6148-RJ45V
  description 2-20
  front panel (figure) 2-20
  inline power 2-20
  LEDs 2-20
WS-X6148V-GE-TX
  description 2-18
  front panel (figure) 2-19
  inline power 2-18
  LEDs 2-19
WS-X6182-2PA
  LEDs 4-3
WS-X6224-100FX-MT
  description 2-20
  front panel (figure) 2-20
  LEDs 2-20
WS-X6248A-TEL
  description 2-21
  front panel (figure) 2-21
  LEDs 2-21
WS-X6248-RJ45
  description 2-21
  front panel (figure) 2-21
  LEDs 2-21
WS-X6248-TEL
  description 2-21
  front panel (figure) 2-21
  LEDs 2-21
WS-X6302-MSM
  front panel (figure) 5-2
WS-X6302-MSM
  front panel (figure) 5-2
WS-X6316-GE-TX
  description 2-29
  front panel (figure) 2-29
  LEDs 2-29
WS-X6324-100FX-MM
  description 2-22
  front panel (figure) 2-22
  LEDs 2-22
WS-X6324-100FX-SM
  description 2-22
  front panel (figure) 2-22
  LEDs 2-22
WS-X6348-RJ-21V
  description 2-23
  front panel (figure) 2-23
  LEDs 2-23
WS-X6348-RJ-45
  description 2-23
  front panel (figure) 2-23
  LEDs 2-23
WS-X6348-RJ45V
  description 2-24
  front panel (figure) 2-24
  LEDs 2-24
WS-X6380-NAM
  WS-X6381-IDS
  description 9-1
  front panel (figure) 9-1
  hard disk LED 9-2
  LEDs (table) 9-2
  PCMCIA slot 9-2
  shutdown button 9-2
WS-X6408A-GBIC
  description 2-29
  front panel (figure) 2-30
  LEDs 2-30
WS-X6408-GBIC
- description 2-29
- front panel (figure) 2-29
- LEDs 2-29

WS-X6416-GBIC
- description 2-30
- front panel (figure) 2-30
- LEDs 2-30

WS-X6416-GE-MT
- description 2-30
- front panel (figure) 2-30
- LEDs 2-30

WS-X6500-SFM2
- description 11-2
- front panel (figure) 11-2
- LCD display 11-2
- LEDs 11-2
- push button switches 11-2
- redundancy 11-2

WS-X6501-10GEX4
- description 2-31
- front panel (figure) 2-31
- LEDs 2-31

WS-X6502-10GE
- description 2-31
- Distributed Forwarding Card upgrade 2-31
- front panel (figure) 2-31
- LEDs 2-31
- OIM support 2-31

WS-X6516A-GBIC
- description 2-32
- Distributed Forwarding Card upgrade 2-32
- front panel (figure) 2-32
- LEDs 2-32

WS-X6516-GBIC
- description 2-31
- Distributed Forwarding Card upgrade 2-31
- front panel (figure) 2-32
- LEDs 2-32

WS-X6516-GE-TX
- description 2-32
- Distributed Forwarding Card upgrade 2-32
- front panel (figure) 2-33
- LEDs 2-33

WS-X6524-100FX-MM
- description 2-24
- front panel (figure) 2-25
- LEDs 2-25

WS-X6548-GE-TX
- description 2-25, 2-27
- front panel (figure) 2-25, 2-27
- LEDs 2-25, 2-27
- QoS port architecture 2-27

WS-X6548-RJ-21
- description 2-26
- front panel (figure) 2-26
- LEDs 2-26

WS-X6548-RJ-45
- description 2-26
- front panel (figure) 2-26
- LEDs 2-26

WS-X6548V-GE-TX
- description 2-25
- front panel (figure) 2-26
- inline power 2-26
- LEDs 2-26

WS-X6608-E1 12-4

WS-X6608-T1
- description 12-4
- front panel (figure) 12-5
- LEDs (table) 12-5

WS-X6624-FXS
- description 12-6
- front panel (figure) 12-6
- LEDs (table) 12-7

WS-X6704-10GE
- description 2-33
- front panel (figure) 2-33
LEDs 2-33, 2-35
QoS architecture 2-33, 2-35
WS-X6724-SFP
  description 2-33
  front panel (figure) 2-33, 2-34
  LEDs 2-33, 2-34
  QoS architecture 2-33
WS-X6816-GBIC
  description 2-34
  front panel (figure) 2-34
  installation restrictions 2-34
  LEDs 2-34