Cisco Reader Comment Card

General Information

1 Years of networking experience _____ Years of experience with Cisco products _____

2 I have these network types: ☐ LAN ☐ Backbone ☐ WAN
☐ Other: _____

3 I have these Cisco products: ☐ Switches ☐ Routers
☐ Other: Specify model(s) _____

4 I perform these types of tasks: ☐ H/W Install and/or Maintenance ☐ S/W Config
☐ Network Management ☐ Other: _____

5 I use these types of documentation: ☐ H/W Install ☐ H/W Config ☐ S/W Config
☐ Command Reference ☐ Quick Reference ☐ Release Notes ☐ Online Help
☐ Other: _____

6 I access this information through: ____% Cisco Connection Online (CCO) ____% CD-ROM
____% Printed docs ____% Other: _____

7 Which method do you prefer? _____

8 I use the following three product features the most:

Document Information

Document Title: Cisco Metro 1500 Series Hardware Installation Guide

Part Number: 78-10588-03

On a scale of 1–5 (5 being the best) please let us know how we rate in the following areas:

_____ The document was written at my technical level of understanding.
_____ The information was accurate.
_____ The document was complete.
_____ The information I wanted was easy to find.
_____ The information was well organized.
_____ The information I found was useful to my job.

Please comment on our lowest score(s):

Mailing Information

Company Name Date

Contact Name Job Title

Mailing Address

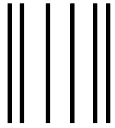
City State/Province ZIP/Postal Code

Country Phone ( ) Extension

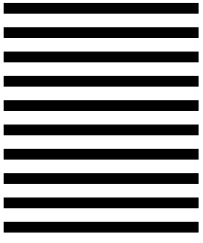
Fax ( ) E-mail

Can we contact you further concerning our documentation? ☐ Yes ☐ No

You can also send us your comments by e-mail to **bug-doc@cisco.com**, or fax your comments to us at **(408) 527-8089**.



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 4631 SAN JOSE CA

POSTAGE WILL BE PAID BY ADDRESSEE

ATTN DOCUMENT RESOURCE CONNECTION
CISCO SYSTEMS INC
170 WEST TASMAN DRIVE
SAN JOSE CA 95134-9883

Cisco Metro 1500 Series Hardware Installation Guide

Corporate 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: 408 526-4100

Customer Order Number: DOC-7810588=
Text Part Number: 78-10588-03

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.

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.

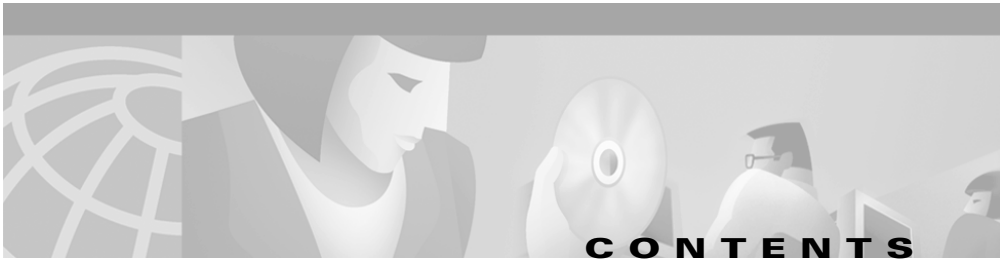
• Plug the equipment into an outlet that is on a different circuit from the television or radio. (That is, make certain the equipment and the television or radio are on circuits controlled by different circuit breakers or fuses.)

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

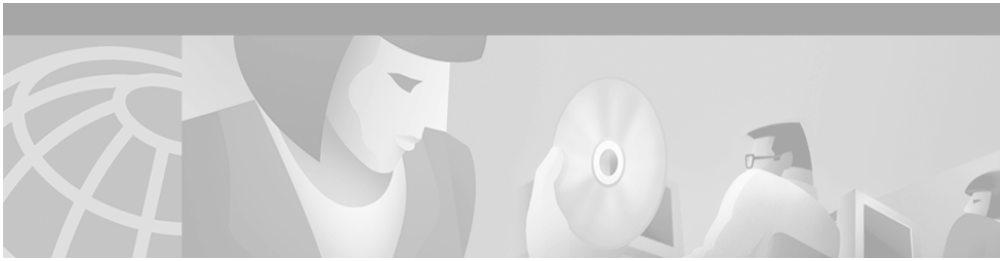
The Cisco implementation of TCP header compression is an adaptation of a program developed by the University of California, Berkeley (UCB) as part of UCB's public domain version of the UNIX operating system.

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.



CONTENTS



Preface

This preface describes the audience, organization, and conventions of the *Cisco Metro 1500 Series Hardware Installation Guide.* It also provides an overview of new information in the guide and how to obtain related documentation or technical assistance.

Note The *Cisco Metro 1500 Series Hardware Installation Guide* replaces the *Cisco Metro 1500 Operations Guide*.

Note To access the most current version of the *Cisco Metro 1500 Series Hardware Installation Guide*, go to the following URL: www.cisco.com/univercd/cc/td/doc/product/mels/cmet1500/hwguide/index.htm

Audience

This guide is intended for network managers who are familiar with the following:

- Hardware installation and configuration
- Linux commands and environment
- Network protocols

New and Changed Information

This guide includes the following new and changed information:

Feature	Description	Chapter or Section
Power supply replacement instructions	The instructions for replacing the power supply are now found in this guide instead of the discontinued *Cisco Metro 1500 Series Spares Installation Guide*.	"Removing the Power Supply Module" section on page 3-21
Optical isolator patch cable	The instructions for installing and using the optical isolator patch cable are now found in this guide instead of the discontinued *Cisco Metro 1500 Series Optical Isolator Configuration Note*.	"Connecting Optical Isolators" section on page 5-14
TDM 4 X ESCON wavelength channel module (WCM)	A new high-performance WCM that uses TDM technology.	"TDM4E Wavelength Channel Modules" section on page 1-31
High-Speed 850-nm multiclock WCM	A new high-performance WCM that operates in the 850-nm transmission wavelength.	"High-Speed WCM with 850-nm Multiclock" section on page A-15.

Organization

This guide describes how to install the Cisco Metro 1500 series system, and it is organized as follows:

Chapter	Title	Description
Chapter 1	Product Overview	Describes the modules that make up the Cisco Metro 1500 series system
Chapter 2	Preparing for Installation	Lists safety considerations and site planning details for operation of the Cisco Metro 1500 series system

Chapter	Title	Description
Chapter 3	Installing the Chassis	Describes how to install the Cisco Metro 1500 series chassis
Chapter 4	Installing the Modules	Describes how to install the modules of the Cisco Metro 1500 series system
Chapter 5	Connecting Optical Cables	Describes how to connect the optical cables of the Cisco Metro 1500 series system
Chapter 6	Connecting Jumpers	Describes how to connect wavelength channels with MUX/DMX, MUX/DMX with band splitter modules (BSMs), and BSM with remote switch modules (RSMs)
Chapter 7	Connecting NEMI and DEMI Modules	Describes how to connect the NEMI and DEMI modules used in the Cisco Metro 1500 series system
Appendix A	Specifications	Includes the technical data for the Cisco Metro 1500 series chassis and modules
Appendix B	Cables and Cabling	Lists the pin-to-pin connections for cables used by the Cisco Metro 1500 series system
Appendix C	NEMI Software Specifications	Lists the hardware and software specifications of the NEMI, settings for an external modem, and the SNMP protocols for the wavelength channel modules (WCMs)
Appendix D	Acronyms	List the acronyms and their expansions used throughout the guide
Appendix E	Unit Maintenance and Network Record	Describes the information to be collected when the system is installed or the configuration is changed
Appendix F	Translated Safety Warnings	Lists the warnings in this guide and translates them into different languages

Conventions

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 *caution should be taken*. Cautions contain information that is important to follow so as not to cause harm to the equipment.

Warnings use the following conventions:

Warning **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. (To see translations of the warnings that appear in this publication, refer to the appendix, "Translated Safety Warnings".)**

Waarschuwing **Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen. (Voor vertalingen van de waarschuwingen die in deze publicatie verschijnen, kunt u het aanhangsel "Translated Safety Warnings" (Vertalingen van veiligheidsvoorschriften) raadplegen.)**

Varoitus **Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista. (Tässä julkaisussa esiintyvien varoitusten käännökset löydät liitteestä "Translated Safety Warnings" (käännetyt turvallisuutta koskevat varoitukset).)**

Attention **Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant entraîner des blessures. Avant d'accéder à cet équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures courantes de prévention des accidents. Pour obtenir les traductions des mises en garde figurant dans cette publication, veuillez consulter l'annexe intitulée « Translated Safety Warnings » (Traduction des avis de sécurité).**

Warnung **Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt. (Übersetzungen der in dieser Veröffentlichung enthaltenen Warnhinweise finden Sie im Anhang mit dem Titel "Translated Safety Warnings" (Übersetzung der Warnhinweise).)**

Avvertenza **Questo simbolo di avvertenza indica un pericolo. Si è in una situazione che può causare infortuni. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti. La traduzione delle avvertenze riportate in questa pubblicazione si trova nell'appendice, "Translated Safety Warnings" (Traduzione delle avvertenze di sicurezza).**

Advarsel **Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskade. Før du utfører arbeid på utstyr, må du være oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker. (Hvis du vil se oversettelser av de advarslene som finnes i denne publikasjonen, kan du se i vedlegget "Translated Safety Warnings" [Oversatte sikkerhetsadvarsler].)**

Aviso **Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos fisicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes. (Para ver as traduções dos avisos que constam desta publicação, consulte o apêndice "Translated Safety Warnings" - "Traduções dos Avisos de Segurança").**

Advertencia **Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes. (Para ver traducciones de las advertencias que aparecen en esta publicación, consultar el apéndice titulado "Translated Safety Warnings.")**

Varning! **Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador. (Se förklaringar av de varningar som förekommer i denna publikation i appendix "Translated Safety Warnings" [Översatta säkerhetsvarningar].)**

Related Documentation

Refer to the following documents for additional information about the Cisco Metro 1500 series system:

- *Cisco Metro 1500 Series Software Configuration Guide*
- *Cisco Metro 1500 Series Release Notes*
- *Cisco Site Preparation and Safety Guide*

Obtaining Documentation

The following sections provide sources for obtaining documentation from Cisco Systems.

World Wide Web

You can access the most current Cisco documentation on the World Wide Web at the following sites:

- http://www.cisco.com
- http://www-china.cisco.com
- http://www-europe.cisco.com

Documentation CD-ROM

Cisco documentation and additional literature are available in a CD-ROM package, which ships with your product. The Documentation CD-ROM is updated monthly and may be more current than printed documentation. The CD-ROM package is available as a single unit or as an annual subscription.

Ordering Documentation

Cisco documentation is available in the following ways:

- Registered Cisco Direct Customers can order Cisco Product documentation from the Networking Products MarketPlace:

  http://www.cisco.com/cgi-bin/order/order_root.pl

- Registered Cisco.com users can order the Documentation CD-ROM through the online Subscription Store:

  http://www.cisco.com/go/subscription

- Nonregistered Cisco.com users can order documentation through a local account representative by calling Cisco corporate headquarters (California, USA) at 408 526-7208 or, in North America, by calling 800 553-NETS(6387).

Documentation Feedback

If you are reading Cisco product documentation on the World Wide Web, you can submit technical comments electronically. Click **Feedback** in the toolbar and select **Documentation**. After you complete the form, click **Submit** to send it to Cisco.

You can e-mail your comments to bug-doc@cisco.com.

To submit your comments by mail, for your convenience many documents contain a response card behind the front cover. Otherwise, you can mail your comments to the following address:

Cisco Systems, Inc.
Document Resource Connection
170 West Tasman Drive
San Jose, CA 95134-9883

We appreciate your comments.

Obtaining Technical Assistance

Cisco provides Cisco.com as a starting point for all technical assistance. Customers and partners can obtain documentation, troubleshooting tips, and sample configurations from online tools. For Cisco.com registered users, additional troubleshooting tools are available from the TAC website.

Cisco.com

Cisco.com is the foundation of a suite of interactive, networked services that provides immediate, open access to Cisco information and resources at anytime, from anywhere in the world. This highly integrated Internet application is a powerful, easy-to-use tool for doing business with Cisco.

Cisco.com provides a broad range of features and services to help customers and partners streamline business processes and improve productivity. Through Cisco.com, you can find information about Cisco and our networking solutions, services, and programs. In addition, you can resolve technical issues with online technical support, download and test software packages, and order Cisco learning materials and merchandise. Valuable online skill assessment, training, and certification programs are also available.

Customers and partners can self-register on Cisco.com to obtain additional personalized information and services. Registered users can order products, check on the status of an order, access technical support, and view benefits specific to their relationships with Cisco.

To access Cisco.com, go to the following website:

http://www.cisco.com

Technical Assistance Center

The Cisco TAC website is available to all customers who need technical assistance with a Cisco product or technology that is under warranty or covered by a maintenance contract.

Contacting TAC by Using the Cisco TAC Website

If you have a priority level 3 (P3) or priority level 4 (P4) problem, contact TAC by going to the TAC website:

http://www.cisco.com/tac

P3 and P4 level problems are defined as follows:

- P3—Your network performance is degraded. Network functionality is noticeably impaired, but most business operations continue.
- P4—You need information or assistance on Cisco product capabilities, product installation, or basic product configuration.

In each of the above cases, use the Cisco TAC website to quickly find answers to your questions.

To register for Cisco.com, go to the following website:

http://www.cisco.com/register/

If you cannot resolve your technical issue by using the TAC online resources, Cisco.com registered users can open a case online by using the TAC Case Open tool at the following website:

http://www.cisco.com/tac/caseopen

Contacting TAC by Telephone

If you have a priority level 1(P1) or priority level 2 (P2) problem, contact TAC by telephone and immediately open a case. To obtain a directory of toll-free numbers for your country, go to the following website:

http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml

P1 and P2 level problems are defined as follows:

- P1—Your production network is down, causing a critical impact to business operations if service is not restored quickly. No workaround is available.
- P2—Your production network is severely degraded, affecting significant aspects of your business operations. No workaround is available.

1

Product Overview

This chapter describes the Cisco Metro 1500 series metropolitan area network (MAN) dense wavelength division multiplexing (DWDM) system, and includes the following sections:

Product Description

The Cisco Metro 1500 series system is a high-performance, wavelength division multiplexer that provides bidirectional data communication. It is designed for communication over optical links in which different devices or applications are communicating over multiple fibers. Using wavelength conversion, several devices can communicate while being connected over one duplex fiber or two single fibers.

The Cisco Metro 1500 series system expands the distance and application capabilities of existing local area networks (LANs), metropolitan area networks (MANs), and storage area networks (SANs). It is protocol-independent and can support virtually any fiber-optic device.

The Cisco Metro 1500 series operates using the International Telecommunication Union (ITU) wavelength grid of 200-GHz channel spacing. It receives the signal from the local device and converts it to the desired wavelength. Only single-mode fibers (remote or trunk fibers) are used for multiplexed data transmission.

The Cisco Metro 1500 series system provides communication within a broad range of data rates, up to 2.488 Gbps, and within a guaranteed optical budget. The system is transparent to any data communication protocol except wavelength channel modules (WCMs) with clock recovery. For more details on data rates, optical budgets, and supported protocols, see Appendix A, "Specifications."

The Cisco Metro 1500 series system also provides monitoring and service functions such as loss of light and bit-rate control, as well as local and remote loopback.

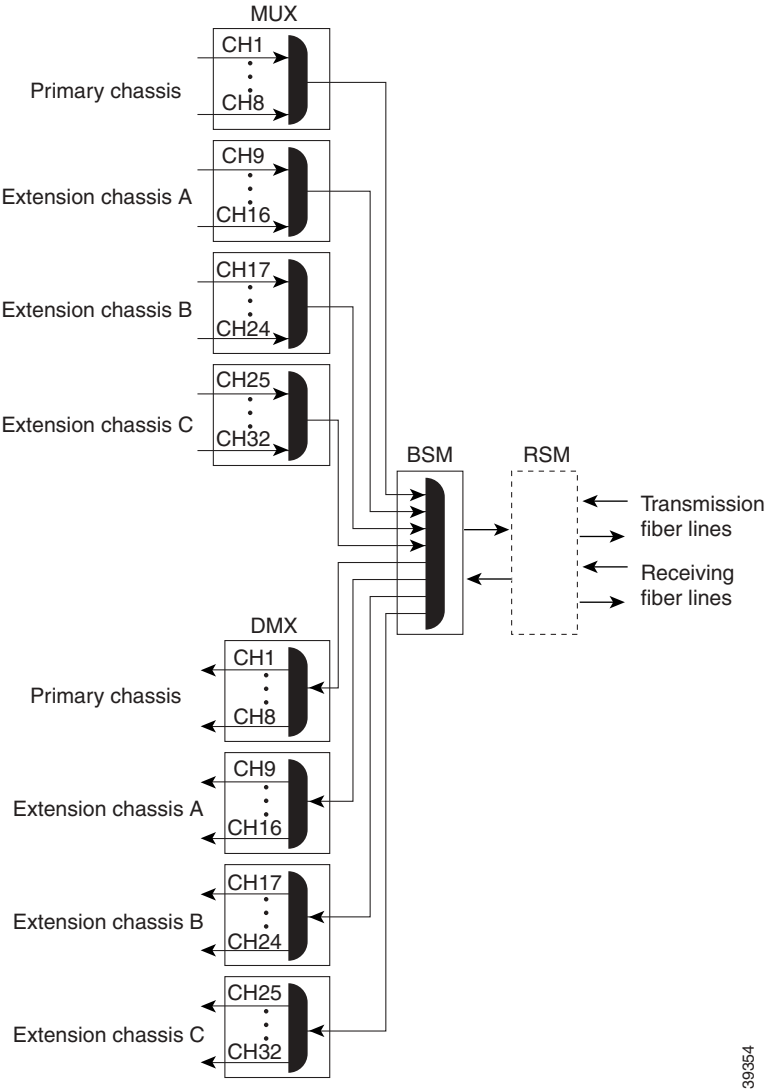
Communication Channels

DWDM technology allows different channels to be combined for transportation over one fiber pair. A pair of multiplexer (MUX) and demultiplexer (DMX) modules assemble the channels into four groups of up to eight channels. The band splitter module (BSM) assembles and disassembles the four groups for the two remote fibers.

The optional remote switch module (RSM) provides line protection to the system. If the working line fails, the RSM routes the combined service automatically to a backup line. If used, the RSM is installed only in the primary chassis.

Figure 1-1 shows the multiplexer architecture.

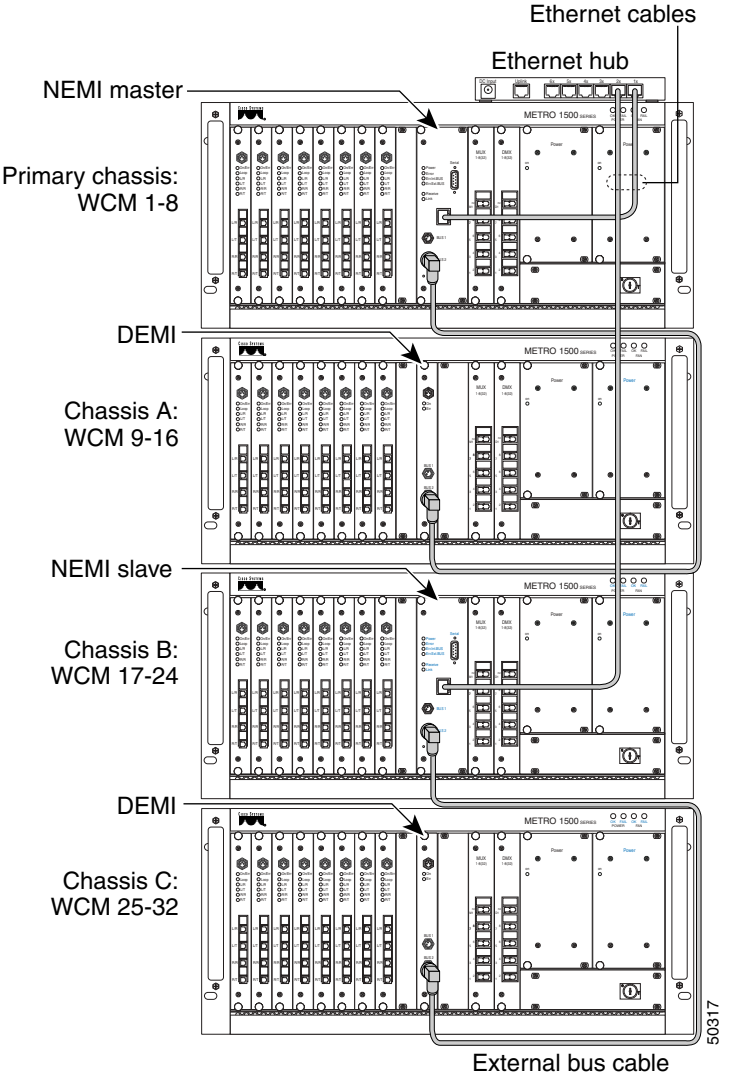
Figure 1-1 Multiplexer Architecture



Primary and Extension Chassis

The Cisco Metro 1500 series system has a modular structure so you can expand the system while it is in use. Adding or removing channels does not affect the other working channels. Figure 1-2 shows a typical Cisco Metro 1500 series system configuration containing a primary chassis and three extension chassis.

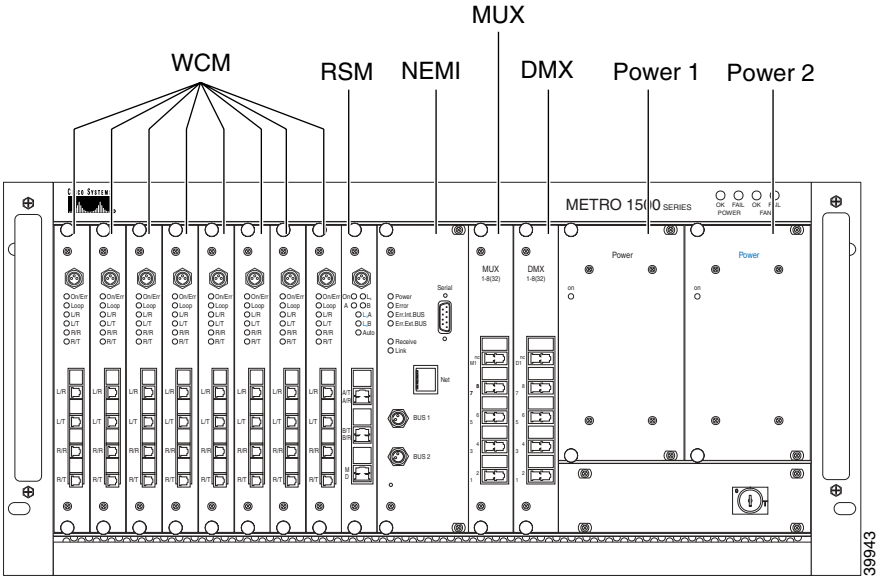
Figure 1-2 Typical Cisco Metro 1500 Series Configuration



Expansion Modules

The Cisco Metro 1500 series system requires two identical WCMs to complete a full communications link, one at each end of the link. Each system unit includes a primary chassis (see Figure 1-3) that holds up to eight WCMs. The WCMs transport up to eight independent channels.

Figure 1-3 Primary Chassis



The Cisco Metro 1500 series system can be expanded by adding more WCMs. Adding extension chassis A, B, and C (Figure 1-4 to Figure 1-6) at both ends of the communications link upgrades the system to transport a total of 32 independent channels. A network element management interface (NEMI) can control up to two chassis and up to four NEMIs can be combined through an Ethernet hub or switch to appear as a single system as seen by a Network Management System (NMS). We recommend that you initially install the primary chassis and extension chassis A, which holds the BSM, to avoid service interruption while upgrading the unit to more than eight channels. The primary chassis and the extension chassis are each equipped with two fully redundant load-sharing, hot-swappable power supply modules (PSMs), as shown in Figure 1-3 to Figure 1-6.

Figure 1-4 Extension Chassis A

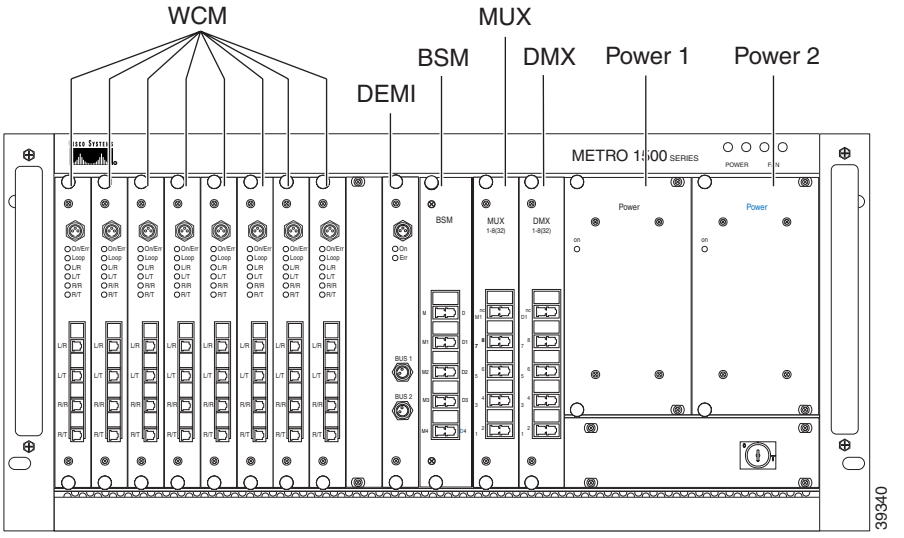


Figure 1-5 Extension Chassis B

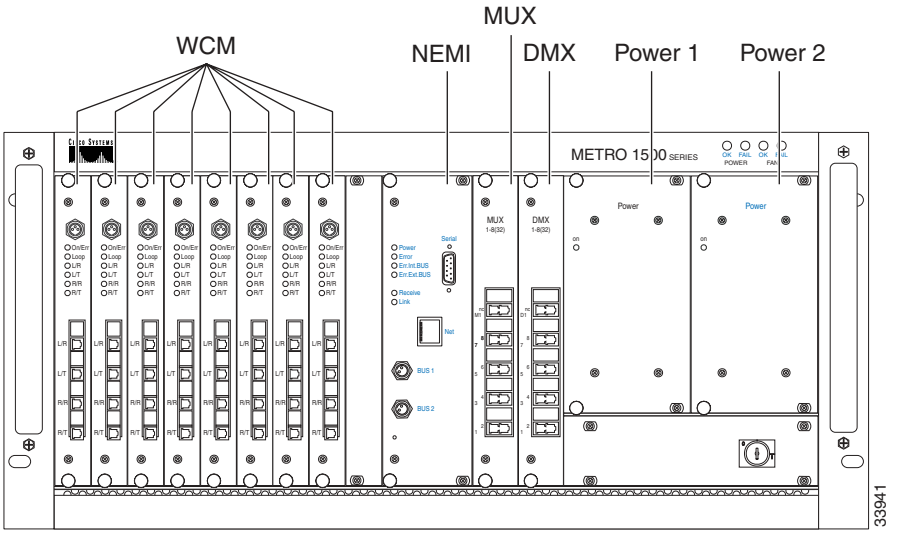


Figure 1-6 Extension Chassis C

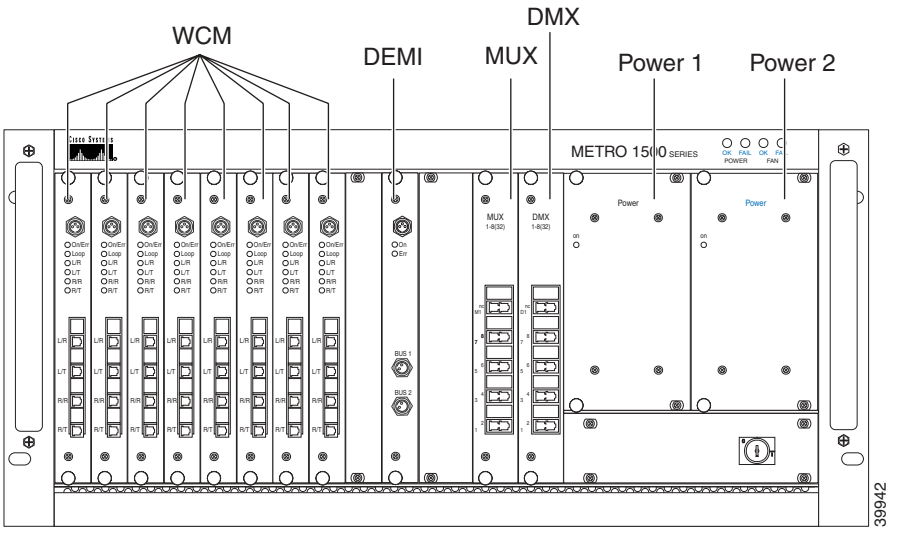
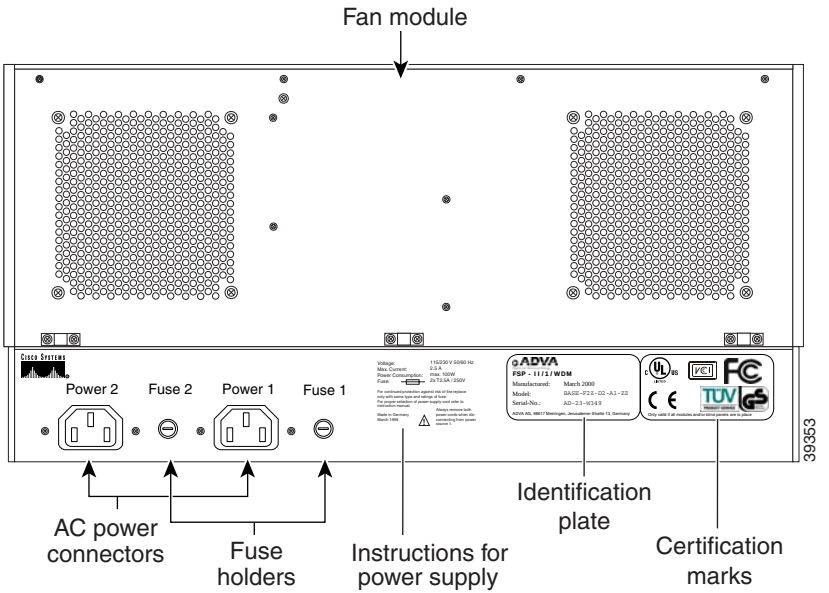


Figure 1-7 shows the rear view of the primary chassis and extension chassis.

Figure 1-7 Rear View of the Chassis



Each chassis is delivered with one to eight WCMs, according to the configuration ordered. Each WCM provides the conversion of the local or remote channels to their respective wavelengths. All modules are hot-swappable and can be repaired or upgraded while the other WCMs are in use. WCMs support a wide range of data rates. For more information on data rates, optical budgets, and supported protocols, see Appendix A, “Specifications,” and Appendix E, “Unit Maintenance and Network Record.”

The RSM is available as an option. The RSM provides the system with 1+1 line protection and is installed in the primary chassis only. (See Figure 1-3).

The primary chassis and extension chassis B also include the network element management interface (NEMI) module. Extension chassis A and C includes an optional device element management interface (DEMI) module. For information on the NEMI and DEMI, refer to the *Cisco Metro 1500 Series Software Configuration Guide*.

Each WCM has fiber-optic cables attached to its front panel. The remote lines of each WCM are connected to the MUX and DMX of the chassis. The common input and output connections of MUXs and DMXs (M1 to M4/D1 to D4) are connected to the BSM (M1 to M4/D1 to D4) in extension chassis A. For more information on the MUX/DMX modules, see the "Multiplexer and Demultiplexer Modules" section on page 1-22. The common input or output of the BSM (MUX/DMX) can be connected to the RSM receiver or transmitter (MUX/DMX) connector. The signals of the remote link are then present at the line A and line B connectors of the RSM.

16-Channel WCM System

A 16 channel WCM system consists of two chassis. Chassis 1 includes the NEMI module and chassis 2 holds the DEMI module. Both NEMI and DEMI have to be interconnected using an external bus cable to allow management and configuration control information to pass between the two chassis. The NEMI is configurable by the customer. For more details, refer to the *Cisco Metro 1500 Series Software Configuration Guide*.

32-Channel WCM System

NEMIs exchange their data over a connection and the two originally independent 16 channel WCM systems appear to the outside as a single 32-channel WCM system. When two 16-channel units are connected in this manner, the NEMI in chassis 1 is configured to be a NEMI-master and the NEMI in chassis 3 is configured to be a NEMI-slave. Both NEMIs are connected through their Ethernet ports to the Ethernet hub. For more details, refer to the *Cisco Metro 1500 Series Software Configuration Guide*.

128-Channel ESCON System

The first NEMI, installed in chassis 1, is configured to be a NEMI-master and the other three NEMIs are all configured as NEMI-slaves. All four NEMIs are connected through their Ethernet ports to the Ethernet hub. Provided that the frames are connected and configured as described, the complete system of eight

frames constitutes a single unified network element with a unique Ethernet address. For more details, refer to the *Cisco Metro 1500 Series Software Configuration Guide*.

Chassis

Each chassis of the Cisco Metro 1500 series can be mounted in a 19-inch cabinet or in open racks. Each chassis requires five rack units. The chassis houses all of the system modules required to achieve the optical communications link.

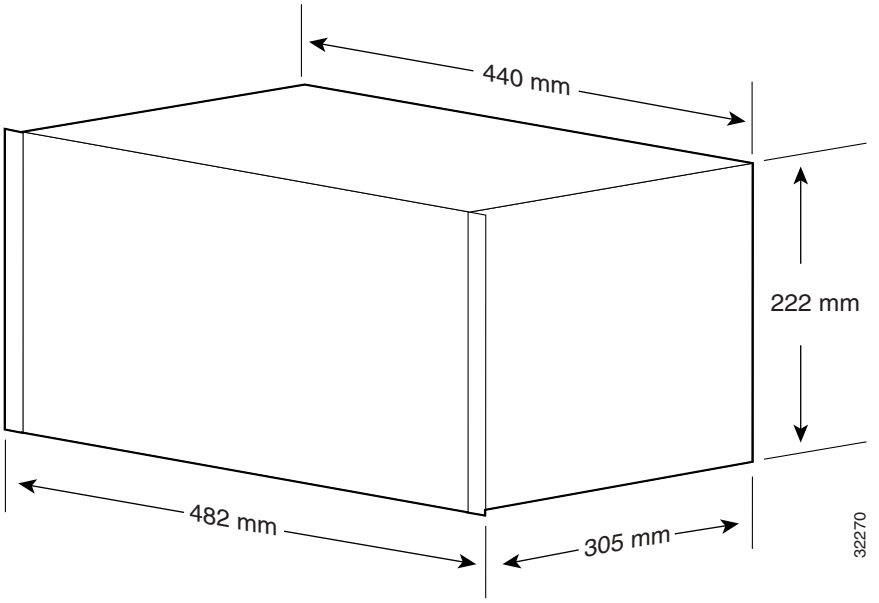
This section describes the following chassis components:

- Dimensions
- Labeling
- Airflow System
- Power Supply Module

Dimensions

The housing is modular in accordance with DIN specification 41494 part 5. The construction comprises two aluminum sides and four aluminum cross extrusions. Standard features also include sheet-steel covers and die-cast aluminum cover extrusions. All covers are uncoated aluminum; cross extrusions, side extrusions, and handles are textured powder-coated. Figure 1-8 shows the dimensions of the chassis.

Figure 1-8 Outer Dimensions of the Housing



Labeling

A label at the back of the unit identifies the system. Each WCM, RSM, and NEMI have unique serial numbers and specification codes printed on the front panels of the modules.

WCMs are labeled with alphanumeric and pictographic descriptions of their main properties. Table 1-1 provides descriptions of the WCM labels.

Table 1-1 WCM Labels

Main Properties	Specification
 622 Mbps	WCM with clock recovery. The clock recovery is fixed to a single frequency as indicated below the symbol.
200 Mbps  125, 155 Mbps	WCM with clock recovery. The clock recovery can be set to three frequencies. These frequencies are shown above and below the symbol.
1250 Mbps  100 Mbps	Transparent WCM without clock recovery ranging from 100 to 1250 Mbps.
L 1310 M	Local port description of WCM. Fiber type is multimode and the communication wavelength is 1310 nm.
R 1550 S	Remote port description of WCM. Fiber type is single-mode and the communication wavelength is 1550 nm.
 4x200 Mbps	TDM4E with clock recovery. The clock recovery is fixed to a single frequency as indicated below the symbol.

Airflow System

The airflow system includes an air intake at the bottom front side of the chassis and a fan module with two fans at the rear of the chassis. Two redundant power supplies power the fan module. The chassis internal air temperature controls the rotational speed of the fans.

The state of the fan module can either be observed through the NEMI-master or it can be read off the fan LEDs at the front side of the chassis. A green light indicates that everything is in working order. A red light signals that either a fan or a fan power supply is not working properly, which does not necessarily endanger the functioning of the air flow system because there are backup fans and fan power supplies. Refer to the *Cisco Metro 1500 Series Software Configuration Guide* for more information about fan observation using the NEMI-master. The ocmstate-f provides information on the fans.

You can check the fan module status on the display panel at the front of the chassis and through the NEMI. For more information about using the NEMI to check the fan status, refer to the *Cisco Metro 1500 Series Software Configuration Guide*.

Caution The fan system can only be replaced by Cisco-trained and -certified technicians.

Power Supply Module

The Cisco Metro 1500 series system provides high reliability in data and telecommunication applications because it has two identical, fully redundant power supplies. Each power supply can take over the power needs of the entire system. These power supplies provide 5V at 30A to the system, and full input-to-output, input-to-case, and output-to-output isolation. For detailed information on the power supply and how to replace it, see the "Determining Power Supply Status" section on page 3-23.

The state of the PSMs can either be observed through the NEMI-Master or it can be read off the LEDs at the front side of the frame. If both PSMs are working the green or red power LED is lit, otherwise there is no light at all.

System Modules

The Cisco Metro 1500 series system is a modular system, in which modules can be added or exchanged during operation. You can adjust the system unit to meet your application requirements. Purchasing a chassis that is not fully populated with modules allows you to upgrade the system at a later time.

This section describes the following system modules:

- Wavelength Channel Modules
- Multiplexer and Demultiplexer Modules
- Band Splitter Module
- Remote Switch Module
- TDM4E Wavelength Channel Modules

Note The network element management interface (NEMI) and the device element management interface (DEMI) are described in the *Cisco Metro 1500 Series Software Configuration Guide*.

The Cisco Metro 1500 series system uses the technology of Dense Wavelength Division Multiplexing (DWDM) to optimize usage of available optical fibers. WCMs convert the local optical signals to separate wavelengths of the ITU-T grid necessary for DWDM. The MUX is a passive high performance module which integrates up to eight optical signals into one wavelength band for transportation through the BSM on one single-mode fiber (Figure 2-13).

The DMX receives the wavelength band from the corresponding MUX at the remote end of the link via the BSM. In the DMX, the wavelength band is split into separate wavelength channels that are transferred to the WCMs for reconversion into the customer application signal as shown in Figure 2-13.

Wavelength Channel Modules

Table 1-2 lists the seven WCMs that are available for the Cisco Metro 1500 series system, their part numbers, and their maximum remote receiver (R/R) input power in decibels per milliwatt (dBm).

Table 1-2 Available WCMs

WCM	Part Number	Maximum R/R[1] Input Power
Low-speed transparent with 100 to 200 Mbps	WCM/LS-T	-5 dBm[2]
High-speed transparent with 100 to 1250 Mbps	WCM/HS-T	-7 dBm
High-speed with 622-Mbps clock	WCM/HS-FC622	-7 dBm
High-speed with 1062-Mbps clock for coupling link	WCM/HS-FC1062-CL	-7 dBm
High-speed with 1062- or 1250-Mbps clock	WCM/HS-MC1062/1250	-7 dBm
2.488 Gbps	WCM-FC2488	-8 dBm

1. R/R = remote receiver
2. dBm = decibels referenced to 1 mW — the standard unit of normalized power level used in optics, where 0 dBm =1 mW, +10 dBm =10 mW.

WCMs are used in pairs. Adding a channel to a communication link requires adding WCMs of the same type and channel number at both ends of the link. The available WCM types are either data rate transparent or they have clock recovery through a fixed or a settable multiclock.

For reasons of laser safety requirements, the WCM is equipped with an automatic laser shutdown (ALS), which reduces the optical output power of the remote transmitter whenever a remote link is broken.

The status of receivers and transmitters can be observed locally with SNMP-based network management tools. In addition, the front panel LEDs provide information on the operating status. Refer to the *Cisco Metro 1500 Series Software Configuration Guide* for more information about this feature.

For service purposes, data can be looped. The loop function is switchable using the network management tools. A local loop connects the electrical output of the local optical receiver with the electrical input of the local optical transmitter. This loop enables a test of the local transmission lines, the local receiver, and the local transmitter. Locally arriving data is directly sent back. A remote loop connects the electrical output of the optical receiver at the remote system to the electrical input of the optical transmitter, so that the data sent to the remote system is directly retransmitted to the local system. This loop enables a test of the remote transmission lines, the MUX/ DMX pair, the remote receiver and remote transmitter pair, and the remote system.

Data Rate Transparent WCMs

The following transparent WCMs are available:

- Low-speed transparent WCM that supports data rates of 100 to 200 Mbps.
- High-speed transparent WCM that supports data rates of 100 to 1250 Mbps.

These WCMs are protocol-transparent, and they support their data rates within a guaranteed optical budget. Locally received optical data enters the local receiver and is electrically transferred to the remote transceiver. It transmits this data in optical form at a certain ITU wavelength into the MUX, which sends the data to the system at the other side of the link. There, the optical data enters first the DMX and then the remote receiver of the system. The data then is electrically transmitted to the local transmitter, which delivers the optical data.

Remotely received optical data from the paired WCMs enters through the DMX into the remote receiver at a specific ITU wavelength. The data is then electrically transmitted to the local transmitter, which delivers the optical data.

You can check the status of receivers and transmitters using the front panel LEDs or with SNMP-based network management tools. For more information on the available network management tools, refer to the *Cisco Metro 1500 Series Software Configuration Guide*.

Data Rate Transparent Front Panel LEDs

The WCM LEDs provide information about its operating status. Table 1-3 describes the LEDs.

Table 1-3 Transparent WCM LED Descriptions

Label	Color[1]	Description
On/Err	Green	Power is on. No software or hardware errors are detected.
	Red	A hardware or software error was detected or the initialization is in progress (during system startup only).
	Red blinking	WCM is in manual setting mode (not shown in case of error).
Loop	Orange	A remote and/or a local loop is established.
L/R	Green	Data is received from the local port.
L/T	Green	Data is transmitted to the local port.
R/R	Green	Data is received from the remote end of the link.
R/T	Green	Data is transmitted to the remote end of the link.
	Green blinking	WCM is in ALS mode; LED blinks once every 10 seconds.

1. Any other state than the ones listed indicates a possible failure in the local system.

WCMs with Fixed Clock Recovery

The following transparent WCMs are available with fixed clock recovery:

- High-speed transparent WCM that supports data rates of 622 Mbps
- High-speed transparent WCM with 1062-Mbps clock for coupling link
- WCM that supports 2.488 Gbps
- WCM with 850-nm multiclock

Note WCMs with settable clock recovery are also available. See the "WCMs with Settable Clock Recovery" section on page 1-20.

Only signals with the designated data rate can be transmitted within a guaranteed optical budget.

Clock Recovery Front Panel LEDs

The WCM LEDs provide information about its operating status. Table 1-4 describes the LEDs.

Table 1-4 Clock Recovery WCM LED Descriptions

Label	Color[1]	Description
On/Err	Green	Power is on. No software or hardware errors are detected.
	Red	A hardware or software error was detected or the initialization is in progress (during system startup only).
	Red blinking	WCM is in manual setting mode (not shown in case of error).
Loop	Orange	A remote and/or a local loop is established.
L/R	Green	Data is received from a local port and the data rate matches the clock frequency.
	Yellow	Data is received from a local port but the data rate does not match the clock recovery frequency.
L/T	Green	Data is transmitted to a local port.
R/R	Green	Data is received from the remote end of the link.
R/T	Green	Data is transmitted to the remote end of the link.
	Green blinking	WCM is in ALS mode; LED blinks once every 10 seconds.
	Off	Data stream is interrupted because the clock frequency does not match the current data rate.

1. Any other state than the ones listed indicates a possible failure in the local system.

Locally received optical data enters the local receiver and is electrically transferred to the remote transmitter using clock-recovery. The clock recovery locks onto the edges of the data signal and restores the signal to the chosen data transmission frequency. The remote transmitter transmits the data in optical form at a certain ITU wavelength to the MUX.

Optical data that is sent by the module on the remote side enters the remote receiver of the local system through the DMX. The data is then electrically transmitted to the local transmitter, which delivers the optical data.

WCMs with Settable Clock Recovery

The following transparent WCMs are available with settable clock recovery:

- High-speed WCM with 1062-Mbps clock
- High-speed WCM with 1250-Mbps clock
- Low-speed WCM with multiclock (WCM/LS-MC)
- High-speed WCM with low-speed multiclock (WCM/HS-LS-MC)
- High-speed WCM with 1062.5- or 1250-Mbit/s clock (WCM/HS-MC1062/1250). The maximum remote receiver (R/R) input power for this WCM is -7 dBm.

These WCMs are similar to the WCMs with clock recovery with the exception that you can change the clock recovery data rate of WCMs with multiclocks.

You can set the clock recovery data rate using network management tools. For more information, refer to the *Cisco Metro 1500 Series Software Configuration Guide*.

Note Be sure to set and enable clocks, disable loopback, and enable automatic mode for the RSM before installing and enabling the Cisco Metro 1500 series systems.

See the “Clock Recovery Front Panel LEDs” section on page 1-19 for LED descriptions.

Optical Connectors of the WCM

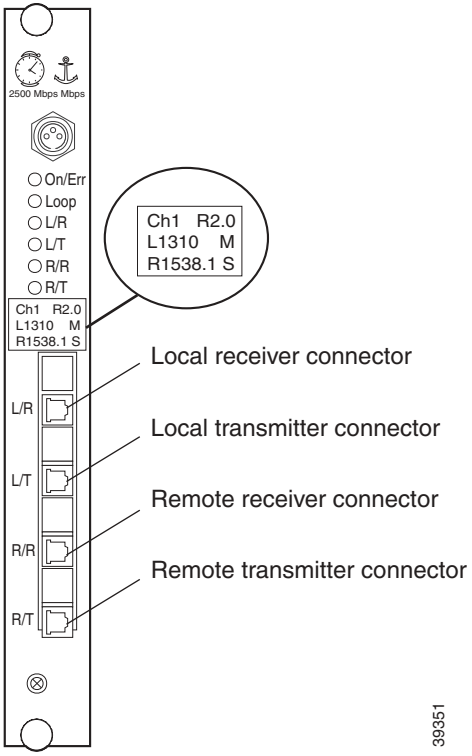
Four optical connectors are located on the front panel of the WCM:

- One local Rx connector (L/R) for local signal input
- One local Tx connector (L/T) for local signal output
- One remote Rx connector (R/R) for remote signal input
- One remote Tx connector (R/T) for remote signal output

Use MiniSC connectors, also called MUPC connectors. See the "Connecting WCMs to MUX and DMX Modules" section on page 5-2 for more information. The front panel of the WCM is shown in Figure 1-9.

Note Some WCMs have a sticker in the middle of the faceplate with the channel number, release status, and wavelength and fiber type of the local and remote ports.

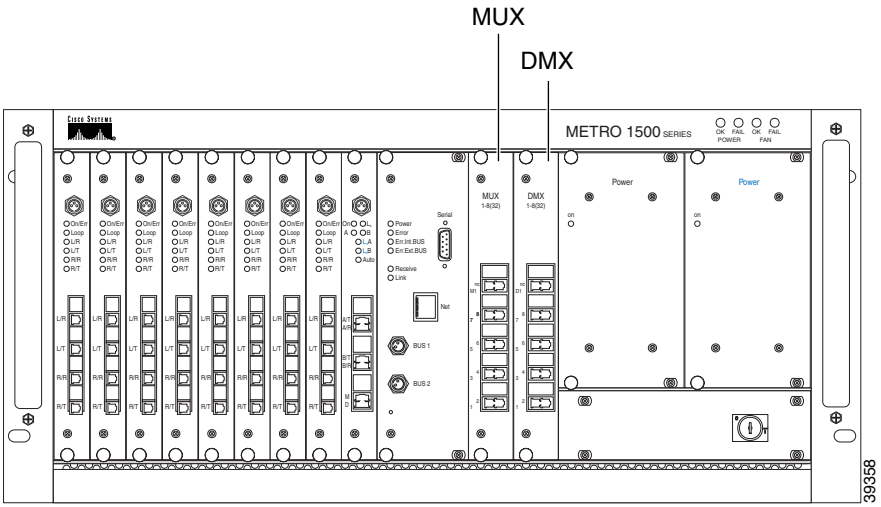
Figure 1-9 Optical Connectors of a WCM



Multiplexer and Demultiplexer Modules

The Cisco Metro 1500 series system uses DWDM technology to convert channels of optical communication into separate wavelengths of the ITU-T grid. The multiplexer (MUX) module combines several optical signals into a combined signal for transportation using one single-mode fiber. The demultiplexer (DMX) module receives the combined signal from the MUX at the remote end of the link. In the DMX, the combined optical signal is separated and fed into eight different fibers. These signals are then transferred to the WCMs for reconversion into the customer's application signal. Figure 1-10 shows the locations of the MUX and DMX in the chassis.

Figure 1-10 MUX and DMX Locations



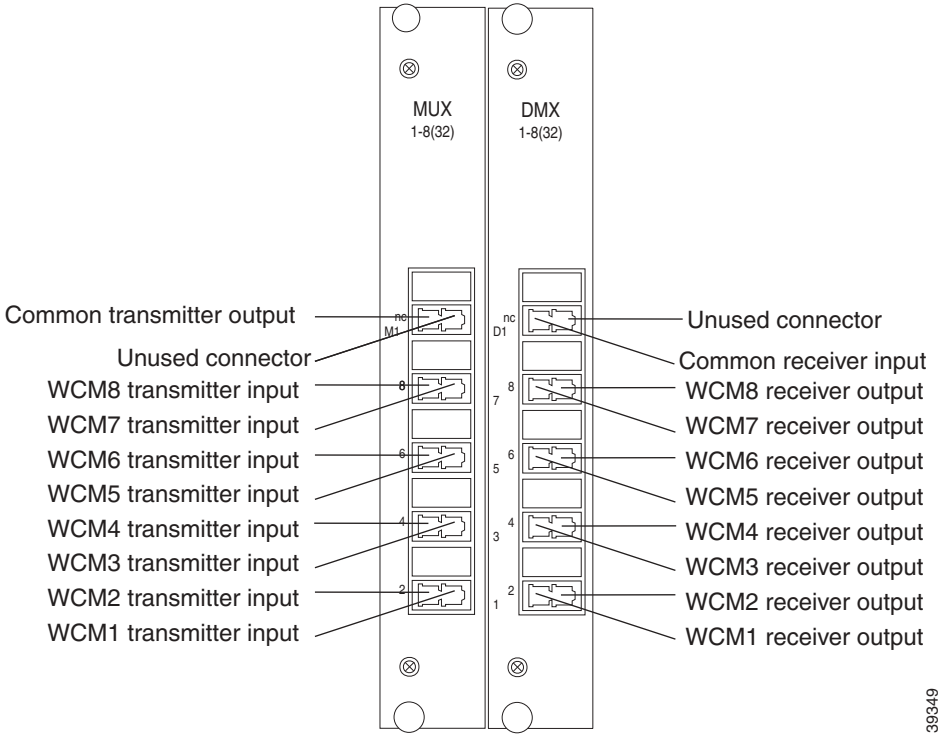
Optical Connectors of the MUX and DMX

Each MUX and DMX has up to 10 optical connectors:

- One input or output connector for each of up to eight WCMs installed in a chassis.
- One common input (D1 to D4 WCM chassis location), depending on the group of channels, or common output (M1 to M4 WCM chassis location), depending on the group of channels.
- One unused connector (nc).

Use MiniSC type connectors. Figure 1-11 shows the front panels of the MUX and DMX. See the "Connecting WCMs to MUX and DMX Modules" section on page 5-2 and "Connecting BSMs with MUX and DMX Modules" section on page 5-4 for more information.

Figure 1-11 Primary Chassis MUX and DMX Connectors



Band Splitter Module

The Cisco Metro 1500 series system uses four channel groups consisting of eight channels of data communication. The band splitter module (BSM) combines and splits these groups of multiplexed optical channels. The group signals from the MUX modules are combined and routed to the input ports and then are multiplexed for data transmission through one fiber to the BSM at the remote side of the link. Simultaneously, the BSM receives the combined signal at its remote input from the remote side of the link. This mixed signal is split into four groups for demultiplexing in the DMX modules.

The BSM is installed in chassis A to avoid service interruption on upgrading the unit to more than 16-channel WCM or 8-channel TDM4E, respectively. This also means that if you only have the primary chassis, you need a chassis A to install a BSM.

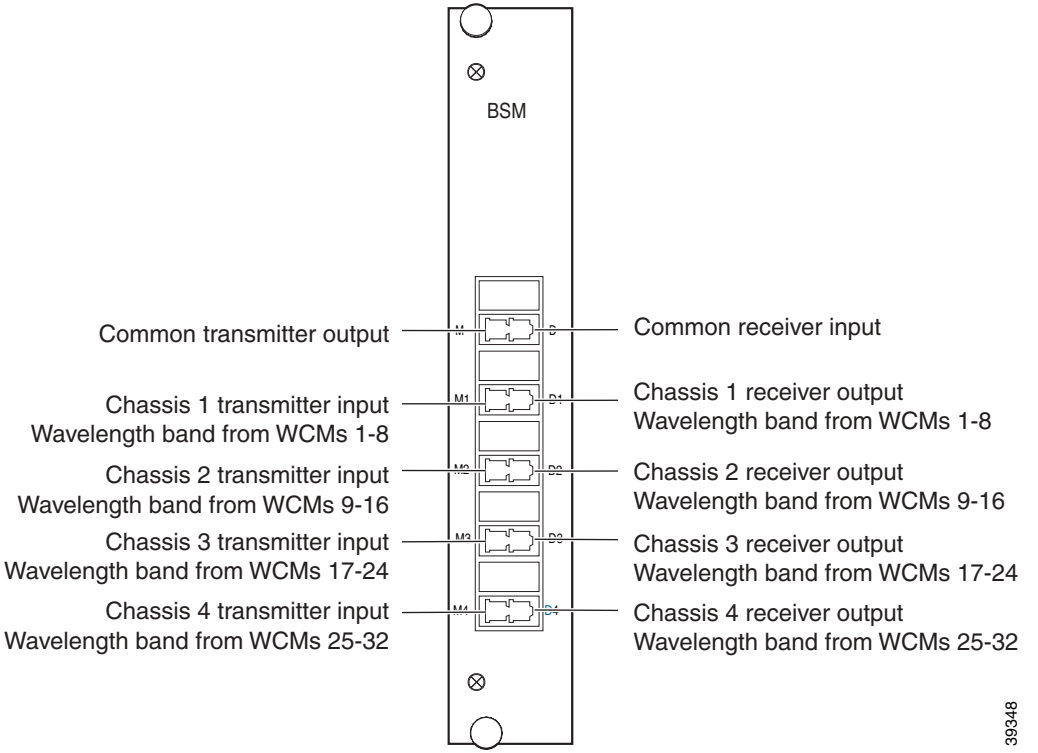
Optical Connectors of the BSM

The BSM has up to 10 optical connectors:

- One input connector (M1 to M4) for each of the four MUX modules
- One output connector (D1 to D4) for each of the four DMX modules
- One common input (D) or common output (M)

All connectors are of the MiniSC type. Figure 1-12 shows the front panel of the BSM. Connecting the BSM is described in the "Connecting BSMs with MUX and DMX Modules" section on page 5-4 and in the "Connecting a BSM to an RSM" section on page 5-6.

Figure 1-12 Optical Connectors of the BSM in a 32-Channel WCM System



Remote Switch Module

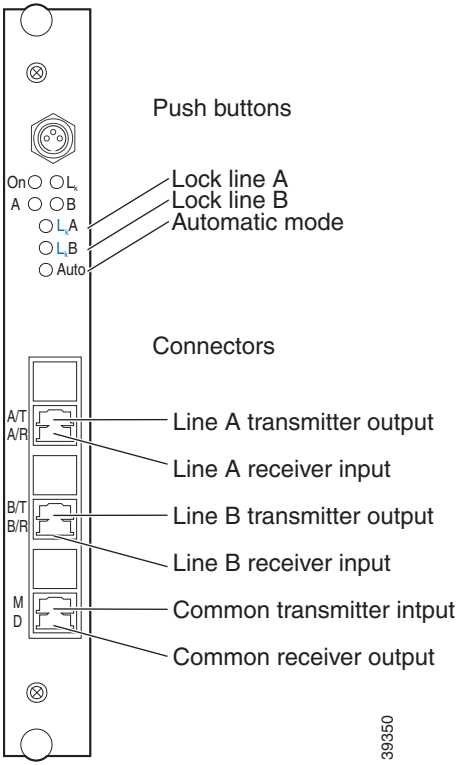
The Cisco Metro 1500 series system can be equipped with an optional optical switch, or remote switch module (RSM), that enhances the system with 1+1 line protection capabilities.

The transmitter and the receiver of the band splitter module (BSM) are single-mode fibers attached to the corresponding connectors of the RSM. The RSM links the communication to one of its remote lines with two fibers each. The active line of the RSM operates as the standard communication path and the other line is the backup path. The backup line is observed continuously. If communication is interrupted in the standard line, the RSM links the communication to the backup line automatically. Switching occurs in less than

50 ms. After switching, the former backup line, now the active line, operates as the standard line and the broken line becomes the backup line. The RSM does not switch back when the backup line recovers.

The RSM can be controlled locally with push buttons at the front panel and remotely using the network element management interface (NEMI) and network management software. For more information on the NEMI, refer to the *Cisco Metro 1500 Series Software Configuration Guide*. Figure 1-13 shows the RSM front panel with its optical connectors.

Figure 1-13 RSM Optical Connectors



RSM Push Buttons and LEDs

Three push buttons control the RSM. Table 1-5 lists each push button and its function.

Table 1-5 RSM Push Button Descriptions

Label	Description
L_k A	Locks the RSM on line A.
L_k B	Locks the RSM on line B.
Auto	Switches the RSM to automatic mode.

Four LEDs indicate the status of the RSM. Table 1-6 describes these LEDs.

Table 1-6 RSM LED Descriptions

Label	Color	Description
On	Green	Power is on. No error is detected.
	Red, continuous	A hardware error is detected.
	Red, blinking	Loss of signal is detected on both remote lines of the RSM. Both remote lines are broken or a hardware error is detected.
A	Green	Line A is active.
	Green, blinking	Line A is inactive. A takeover of the communication is possible.
	Red	Line A is broken and active.
	Red, blinking	Line A is broken and inactive.
B	Green	Line B is active.
	Green, blinking	Line B is inactive. A takeover of the communication is possible.
	Red	Line B is broken.
L_k	Yellow	RSM is locked to one line. No automatic switching is possible.

Optical Connectors of the RSM

Table 1-7 lists the six optical connectors of the RSM. Figure 1-13 shows the front panel of the RSM and its optical connectors.

Table 1-7 RSM Optical Connector Descriptions

Label[1]	Description
A/T	Line A transmitter
A/R	Line A receiver

Table 1-7 RSM Optical Connector Descriptions (continued)

Label[1]	Description
B/T	Line B transmitter
B/R	Line B receiver
D	Transmitter output to the BSM
M	Receiver input from BSM

1. All connectors are of the MiniSC type.

Modes of Operation

The RSM supports two operation modes: automatic mode and lock mode. Automatic mode is the normal mode that enables the switching function of the RSM. The lock mode is used for line testing and for servicing purposes.You can switch between the modes by pushing the appropriate button on the RSM front panel or by using the NEMI.

The RSM ships set to automatic mode and line A is the active line. Line B is the backup line. By default, the RSM does not save its last setting in the event of a power loss.

After power on, the RSM is set to automatic mode and one line is the active line while the other line operates as backup line. The RSM permanently monitors the availability of both line A and line B.

If line A breaks and the backup line (line B) is functioning, the RSM links the communication to line B. After line A recovers no further switching takes place. Line B continues to operate as the active line and line A as the backup line. The same applies when the active line B breaks.

The RSM monitors the accessibility of the backup line. If line A breaks and if line B is functional, the RSM links the communication to line B.

If line A is the active line and you lock the RSM to line B, the RSM checks the accessibility of line B. If line B is functional, the RSM switches the communication to line B and holds the communication on this line. Automatic switching to the backup line (line A) is stopped. If line B is broken, the RSM cannot be locked to line B.

If line B is the active line and you lock the RSM on line B, no switching takes place. The communication is locked on line B. Any automatic switching to the backup line (line A) is stopped.

If line B is the active line and you lock the RSM to line A, the RSM checks the accessibility of line A. If line A is functional, the RSM switches the communication to line A and holds the communication on this line. Any automatic switching to the backup line (line B) is stopped. If line A is broken, the RSM cannot be locked on line A.

At any time, the RSM can be switched from lock mode to automatic mode.

If neither line A nor line B is connected to the RSM or both lines are broken, the red on LED blinks. Also, line A and line B LEDs are red as a visual signal to check for disconnected lines.

The push buttons below the LEDs allow you to switch between automatic mode and lock mode. Lock mode can be enabled for either line A or line B. If the lock mode for one line is activated, the communication cannot be automatically switched to the other line.

Lock mode can be enabled either for an active line or for a backup line. If the active line is locked, the communication cannot be switched to the backup line. If lock mode is enabled for a current backup line by pressing the respective button, the RSM checks the availability of the backup line and (if the line is in working order) switches the communication to it, so that it becomes the active line and locks it. Now, automatic switching to the backup line is impossible.

If the red on LED blinks and one of the A and B LEDs is red while the other one is flashing red, this indicates two possible situations: neither line A nor line B are connected to the RSM or both lines are broken. In this situation, the lock mode can be activated once for testing purposes.

TDM4E Wavelength Channel Modules

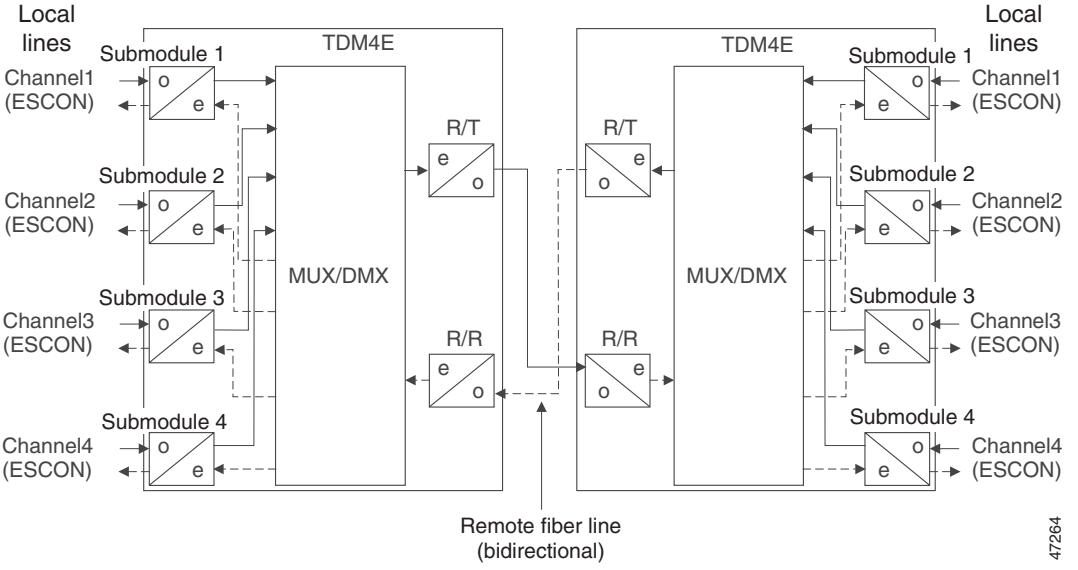
The Cisco Metro 1500 series system can be equipped with an optional time-division multiplexing 4 x ESCON (TDM4E) wavelength channel module. The TDM4E uses TDM technology to provide a transmission capacity four times higher than conventional WCMs. TDM technology allows you to combine 4 200 MB ESCON channels into one WDM channel, making optimal use of the available fiber bandwidth.

Note ESCON (Enterprise System Connection) is an IBM registered trademark.

Each TDM4E contains four submodules (or interfaces) that guarantee optical receiving and transmission. These optical ESCON interfaces are connected to the MUX/DMX unit on the main board of the TDM4E. The MUX/DMX modules electrically multiplex and demultiplex asynchronously up to four ESCON channels to one optical channel for transmission.

The remote transmitter (R/T) generates the optical output signal and feeds it into the remote line. The remote receiver (R/R) receives the optical signal from the remote end of the communication link, converts it into an electrical signal, and then transfers it to the MUX/DMX module. Figure 1-14 shows a typical TDM4E system configuration.

Figure 1-14 TDM4E System Configuration (One Wavelength Only)

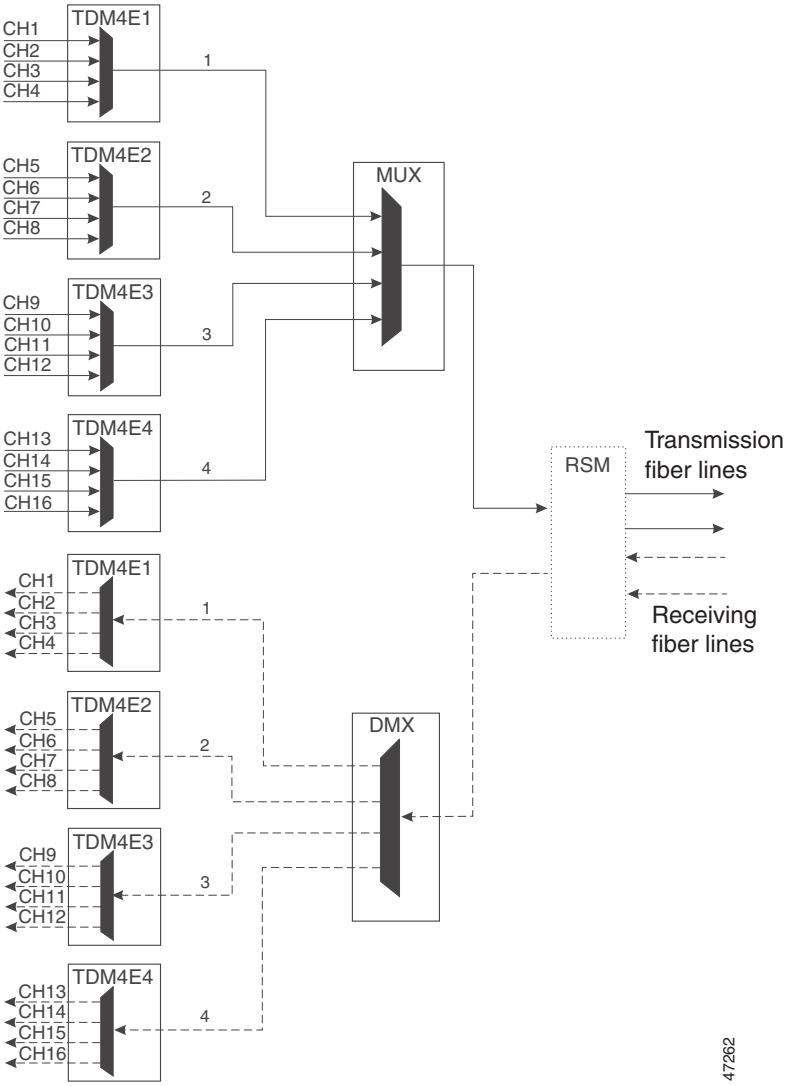


The local ports use multimode fibers. Remote data is transmitted bidirectionally using single-mode fiber only.

All TDM4Es can be replaced or added at any time during operation of the system. Setting up a communication link requires a pair of fully identical TDM4Es. Up to four channels of optical communication of the TDM4E are converted to separate wavelengths of the ITU-T grid for DWDM.

The multiplexer module (MUX) combines the optical signals into a combined signal for transportation using one single-mode fiber to the optional remote switch module (RSM). The RSM enhances the system with a 1 + 1 line protection. The demultiplexer module (DMX) receives the combined signal from the optional RSM. In the DMX, the combined optical signal is separated into the original wavelengths of optical communication. These signals are then transferred to the TDM4Es for reconversion into the application signal. (See Figure 1-15.) The TDM4Es support the 200 Mbit/s clock rate used by the ESCON protocol.

Figure 1-15 TDM4E Multiplexer Architecture



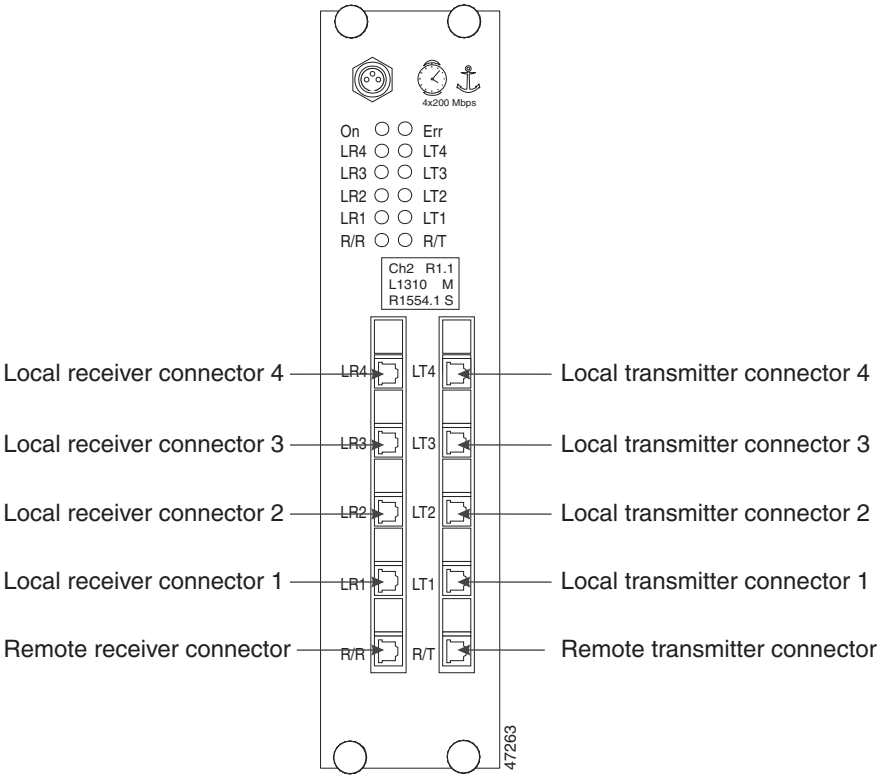
Optical Connectors of the TDM4E

On the front panel of the TDM4E there are 10 MiniSC type optical connectors:

- Four local Rx connectors (L/R) for local signal input
- Four local Tx connectors (L/T) for local signal output
- One remote Rx connector (R/R) for remote signal input
- One remote Tx connector (R/T) for remote signal output

Figure 1-16 shows the optical connectors on the front panel of the TDM4E.

Figure 1-16 Optical Connectors of the TDM4E



TDM4E LEDs

TheTDM4E LEDs provide information about its operating status. The Gigabit Ethernet connection is typically equipped on the remote receiver side with a fixed clock rate of 1250 mbit/s. A complete loss of optical signal on the remote receiver causes the remote laser to automatically shut down.

Table 1-8 describes the functions of each LED. If the system is operational and all interfaces are properly connected, all active TDM4E receive and transmit LEDs are continuously on.

Table 1-8 TDM4E LED Descriptions

Label	Color	Description
On	Green	Power is supplied to the TDM4E.
LR4	Solid green	Data is received from a local port. Data rate matches clock frequency.
	Blinking green	Local port is enabled.
	Solid yellow	Data is received from a local port. Data rate does not match clock frequency and the local clock is unlocked.
	Blinking yellow	Local port is disabled.
LR3	Solid green	Data is received from a local port. Data rate matches clock frequency.
	Blinking green	Local port is enabled.
	Solid yellow	Data is received from a local port. Data rate does not match clock frequency and the local clock is unlocked.
	Blinking yellow	Local port is disabled.
LR2	Solid green	Data is received from a local port. Data rate matches clock frequency.
	Blinking green	Local port is enabled.
	Solid yellow	Data is received from a local port. Data rate does not match clock frequency and the local clock is unlocked.
	Blinking yellow	Local port is disabled.

Table 1-8 TDM4E LED Descriptions (continued)

Label	Color	Description
LR1	Solid green Blinking green	Data is received from a local port. Data rate matches clock frequency. Local port is enabled.
	Solid yellow Blinking yellow	Data is received from a local port. Data rate does not match clock frequency and the local clock is unlocked. Local port is disabled.
LT4	Green	Data is transmitted to a local port.
LT3	Green	Data is transmitted to a local port.
LT2	Green	Data is transmitted to a local port.
LT1	Green	Data is transmitted to a local port.
R/T	Green	Data is transmitted to the remote end of the link, or the remote laser is forced on.
	Blinking yellow/red	Remote laser is forced on while local loop is activated.
R/T	Flashing green	ALS[1] occurred when the green LED flashes every 10 seconds.
R/T R/R	Yellow	Local loop is activated.
R/R	Green	Data is received from the remote end of the link. Data rate matches the clock frequency. The remote transmitter from the remote end of the link and the remote receiver from the local end are synchronized
	Yellow	Data is received from the remote end of the link. Data rate matches the clock frequency, but the remote transmitter from the remote end of the link and the remote receiver from the local end are not synchronized.
ERR	Solid red Blinking red	An error has occurred. Card initialization or local loop is activated or the remote laser is forced on.

1. ALS = automatic laser shutdown

The TDM4E channel modules are double width. A maximum of four modules can be placed in one chassis.

Network Element Management Interface

The NEMI is a two-slot plug-in module that can be configured by software to be either a NEMI-master or a NEMI-slave. The NEMI resides in the following chassis: in the primary chassis (Figures 2-3 and 2-4), chassis B (Figure 2-6), chassis D, and chassis F. This interface provides status and configuration capabilities.

A management computer can be connected directly to the NEMI when using a serial LapLink cable or a crossover Ethernet cable. Ethernet networks with more than two computers require an Ethernet hub. The NEMI functions under version 2.0.35 of the Linux operating system.The NEMI module provides the following:

- Connection to the network using standard Internet protocols
- Remote management and configuration of all interconnected chassis
- SNMP monitoring and trap generation

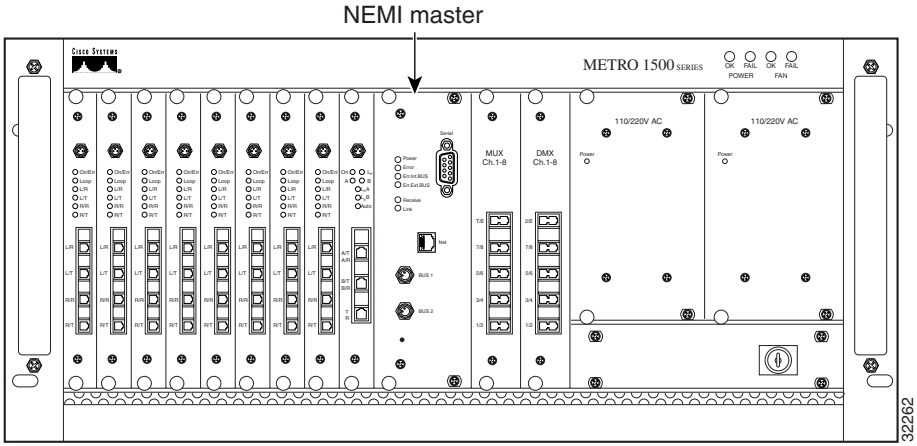
Systems with 24 to 32 channels require the installation of a second NEMI module in extension chassis B. When the two NEMI modules are interconnected using an inter-NEMI network connection (INNC), one NEMI module is configured as the NEMI-master, while the second is configured as the NEMI-slave.

Note The NEMI-master and the NEMI-slave are physically identical modules and differ only in software configuration.

NEMI Location Placement

The physical location of the NEMI module (either master or slave) in the chassis is the same. See Figure 1-17.

Figure 1-17 NEMI Location in the Primary Chassis and Extension Chassis B



NEMI Ports

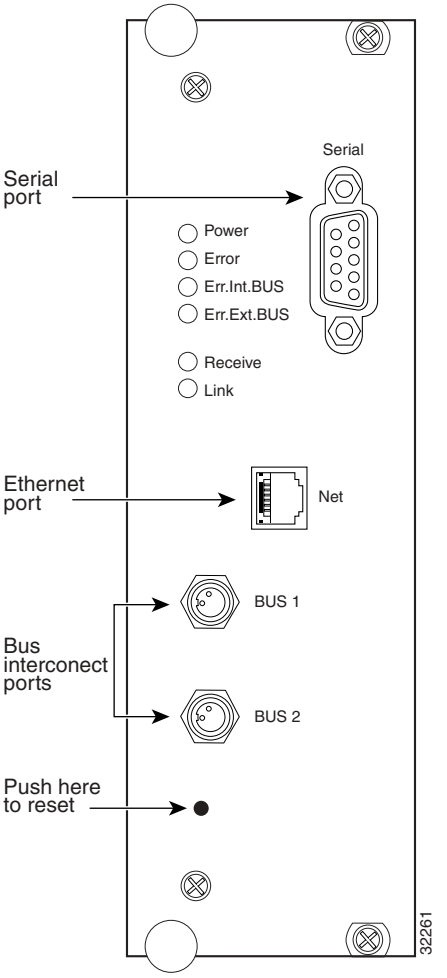
Each NEMI module contains four ports:

- One serial port (RS-232)
- One Ethernet port (10BASE-T)
- Two bus interconnect ports

You can use the Ethernet port to connect the NEMI to the network or to another computer. You can use the serial port to connect the NEMI to a computer for initial system configuration using PPP, for connection to modems or terminal servers, or for interconnecting two NEMI modules.

You can use bus interconnect ports to connect the NEMI-master or the NEMI-slave with the corresponding DEMI module using external bus cables. The front panel of the NEMI is shown in Figure 1-18.

Figure 1-18 NEMI Front Panel



NEMI LEDs

Table 1-9 describes the functions of the LEDs shown in Figure 1-18.

Table 1-9 NEMI LED Descriptions

LED	Color	Description
Power	Green	Power is on.
Error	Red	An error is occurring.
Err. Int. BUS	Red	An error on the internal bus is occurring.
Err. Ext. BUS	Red	An error on the external bus is occurring.
Receive	Blinking green	Link is active; traffic is on the network.
Link	Green	Link is established. The 10BASE-T network link is established.

For more information about NEMIs, refer to the *Cisco Metro 1500 Series Software Configuration Guide*.

Device Element Management Interface

The device element management interface (DEMI) is a single-slot module that resides in chassis A, C, E, and G. This interface provides status and configuration capabilities of the extension frame in which it is installed to the corresponding NEMI. A DEMI module is needed to administer systems with more than 8 WCMs or 4 TDM4Es. A DEMI and a NEMI have to be linked by an external bus cable. The DEMI module provides the following:

- Monitoring of the system bus in the extension chassis in which it is installed.
- Bidirectional communication to the NEMI to which it is physically attached using an external bus cable. Management and configuration control information is passed to and from the attached NEMI.

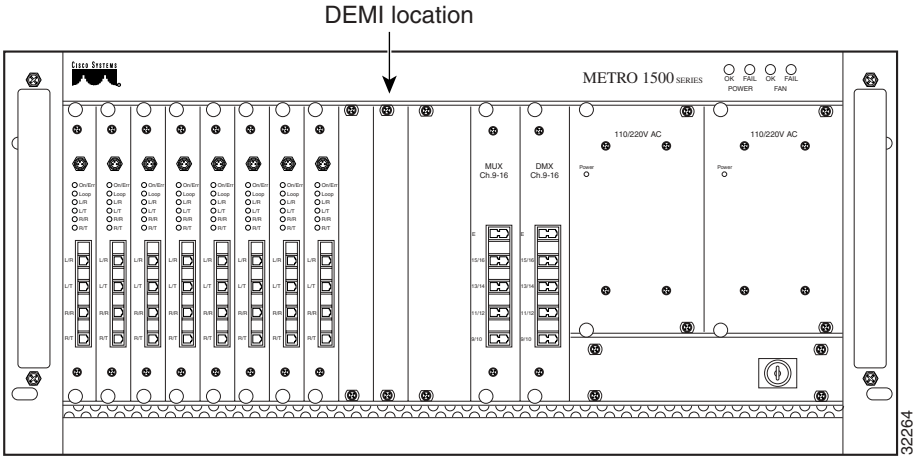
Systems with 24 to 32 channels require the installation of a second DEMI in extension chassis C.

The DEMI module in extension chassis A connects to the NEMI-master module in the primary chassis. The DEMI module in extension chassis C connects to the NEMI-slave module in extension chassis B.

DEMI Location Placement

The physical location of the DEMI module is shown in Figure 1-19.

Figure 1-19 DEMI Placement in an Extension Chassis

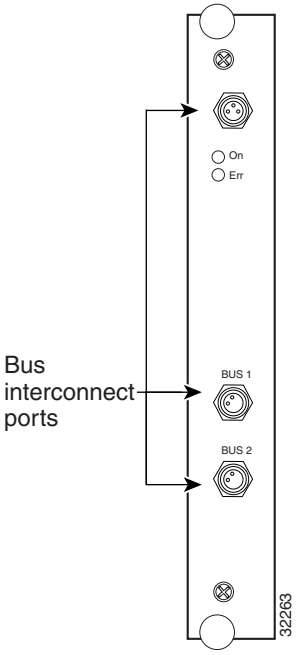


DEMI Ports

Each DEMI contains three bus interconnect ports. The unlabeled bus interconnect port at the top of the DEMI module is not currently implemented. The other ports are labeled BUS1 and BUS2. You can interconnect the DEMI to a NEMI using an external bus cable.

Figure 1-20 shows the front panel of the DEMI.

Figure 1-20 DEMI Front Panel



DEMI LEDs

Table 1-10 describes the functions of the LEDs shown in Figure 1-20.

Table 1-10 DEMI LED Descriptions

LED	Color	Description
On	Green	DEMI is on.
Err	Red	An error is occurring.

For more information about DEMIs, refer to the *Cisco Metro 1500 Series Software Configuration Guide*.

Ethernet Hub

An Ethernet hub is necessary in systems consisting of more than two chassis. The hub is used to connect two or more NEMIs with each other and the Network Management System (NMS). It allows network management from a single point in the network.

CHAPTER 2

Preparing for Installation

This chapter provides site planning and basic safety information for installing the Cisco Metro 1500 series system. It includes the following sections:

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.**

Site Planning

This section describes site planning, which includes information on power requirements, equipment testing, preparing the site, and coordinating the installation process.

Note Certain electrical or environmental modifications might need to be made and verified before the equipment can be installed.

Power Requirements

The Cisco Metro 1500 series system is available in two versions:

- Universal, 110 to 240 VAC
  50 to 60 Hz, 2.5A
- -48 VDC

The DC-powered version requires a -48V battery-based supply. Table 2-1 describes the power requirements in different regions.

Table 2-1 Power Requirements

Region	Power Requirements
North America	110 VAC, 60 Hz
Europe	220 to 240 VAC, 50 Hz

Fiber-Optic Cable Testing

The input ports use multimode, single-mode, or a combination of both types of cables depending on the customer application. The output ports use single-mode cables only.

Remote Link Testing

The remote link must be tested to verify that it meets the specifications and to ensure proper operation.

The supplier of the fiber-optic cable may have a test report available. If no report is available, remote link tests must be performed to verify that parameters are within specifications. Table 2-2 lists the remote link tests required, the measurement the test is to be specified in, and the instrument required to perform the test.

Table 2-2 Remote Link Tests

Remote Link Test	Specified In	Instrument Required
Link optical loss at 1550 nm	Decibels referenced to 1 mW	Laser source at 1310 nm and 1550 nm and power meter or optical time domain reflectometer (OTDR)
Distance	Kilometers	OTDR
Return optical loss at 1550 nm	Decibels	Reflectometer or OTDR with reflectometer

Cord Selection for Operation in USA and Canada

Use a detachable electrical cord with national certification (type SVT or SJT). One end terminates in a NEMA-style attachment plug rated for supply voltage (120V or 240V), and the other end attaches to an IEC 320-type appliance coupler.

Warning **This unit might have more than one power cord. To reduce the risk of electric shock, disconnect the two power supply cords before servicing the unit.**

Preparing Your Site

This section describes the various tasks required for preparing your site for installation, and it indicates who (you or the Cisco authorized representative) is responsible for these tasks.

Shared Site Preparation Responsibilities

You and the Cisco authorized representative share the following site preparation responsibilities:

- Identify who will be installing and testing the system.
- Select an appropriate location for the system unit.
- Determine the cable routing paths and routing method (cable tray, conduit, or other means).
- Calculate the cable distance and optical budget, and order the cables.
- Install AC or DC power receptacles and circuits, if necessary.
- Prepare the floor.

Cisco Installation Responsibilities

The Cisco authorized representative is responsible for the following installation tasks:

- Reviewing the "Power Requirements" section on page 2-2 and the "Cisco Authorized Personnel Checklist" section on page 2-5.
- Installing the hardware at the designated location.
- Connecting all fiber-optic cables.
- Testing the hardware and communications link offline.

Note You and the Cisco authorized representative are jointly responsible for online testing.

Cisco Authorized Personnel Checklist

The Cisco authorized representative can use the following checklist to ensure that the site is ready for installation:

- Does the equipment location have an acceptable clearance for service?
- Are power receptacles located within 5 feet (1.5 m) of the unit and have they been tested for the proper voltage?
- Have fiber-optic interface cables been installed and clearly labeled?
- Has local input power been tested and confirmed to be within budget?
- Have local and remote lines been tested and shown not to exceed the optical budget?
- Are floor tile cutouts for cable access the right size?
- Does the site meet temperature and humidity specifications?
- Has the fiber communication network been tested?

Customer Responsibilities

In addition to providing the necessary support personnel to help with the installation, you are responsible for the following site preparation tasks:

- Review the "Power Requirements" section on page 2-2 and the "Customer Checklist" section on page 2-6.
- Purchase, install, and label the interconnecting fiber-optic cables between the system and the existing fiber-optic network.
- Test and record individual line losses.
- Provide the required electrical power, and ensure that receptacles are within 5 feet (1.5 m) of the system.
- Provide cutouts in the floor tiles for cable access.
- Provide online test jobs to verify the operation before actual production runs.

Customer Checklist

Use the following checklist to ensure that the site is ready for installation:

- Does each unit have the specified access clearance?
- Is each unit within 5 feet (1.5 m) of power receptacles?
- Are required fiber-optic cables available and clearly labeled?
- Are floor tile cutouts for cable access the right size?
- Has cable routing been determined and performed?
- Have personnel been allocated for installation and testing?
- Has interface cable installation been arranged?
- Has pilot online testing been formulated?
- Does site meet temperature and humidity specifications?

Safety Steps

To assure correct and reliable operation of the system, be sure to follow all warning and caution marks in this guide.

If any problems occur, stop operating the system and follow these steps:

Step 1 Turn the keyswitch to the off position.

Step 2 Disconnect the power cords at the rear of the unit.

Step 3 Call your customer service representative.

System Environment

Being careful to avoid humidity and dust, install the system horizontally in a clean environment. Air conditioning is required. Do not expose the system to direct sunlight or heat sources. Locate the system in a restricted area.

Warning **This unit is intended for installation in restricted access areas. A restricted access area is where access can only be gained by service personnel through the use of a special tool, lock and key, or other means of security, and is controlled by the authority responsible for the location.**

Caution Any modifications to the site that are required for Cisco Metro 1500 Series system installation must comply with local building and electrical codes.

Electrical Safety

Before switching this Cisco Metro 1500 series system on, make sure that it has been properly grounded through the protective conductor of the AC or DC power connector to a power outlet with a protective ground contact.

Caution There are many points inside the system which can, if contacted, cause personal injury. Be extremely careful when opening the housing.

Any adjustments or service procedures that require operation of the system with the protective covers removed should be performed only by Cisco authorized service personnel.

If the system is not used as specified, the protection provided by the equipment could be impaired. This system must be used in a normal condition (in which all means for protection are intact) only.

The Cisco Metro 1500 series system operates with AC power ranging from 110 to 240 VAC or -48 VDC, depending upon the product version that you have ordered.

For operation in various countries, power cords specific to the country of operation will be supplied. For proper operation of the system, use the appropriate power cord.

Eye Safety

Warning **Class 1 laser product.**

Eye safety for the user of the system is guaranteed for both the remote and local output channel. Only remove the dust cover from the remote or local output channel (Tx) adapter for installation procedures.

CHAPTER 3

Installing the Chassis

This chapter describes how to install and test the Cisco Metro 1500 series system chassis. The equipment is installed during normal working hours. It is usually connected to active CPU channels or control units after working hours.

This chapter includes the following sections:

Before Installing

Before you install the system, you must complete the following tasks:

- Unpacking and Inspecting the System
- Maintaining a Network Record
- Mounting the System

Caution Use extreme care when removing or installing connectors so you do not damage the connector housing or scratch the end-face surface of the fiber. Always install protective covers on unused or disconnected components to prevent contamination. Always clean fiber connectors before installing them.

Unpacking and Inspecting the System

The Cisco Metro 1500 series system comes with the following standard items:

- Cisco Metro 1500 series hardware
- Substitute power-on key (AC powered version only)
- Mounting set
  - 19-in. adapter
  - rack screw
  - washers
- Two power cords for each chassis delivered
- Acrylic cover
- *Cisco Metro 1500 Series Hardware Installation Guide*
- *Cisco Metro 1500 Series Software Configuration Guide*
- *Release Notes for the Cisco Metro 1500 Series*

Note The systems are used in pairs. Depending on your order, a total system package can consist of multiple boxes. All boxes are labeled with a summary of contents, and they are signed and verified by a packager. If an order includes more than one box, this summary will show the number of boxes shipped.

The Cisco Metro 1500 series system is thoroughly inspected before shipment. If any damage has occurred during transportation or if any item is missing, notify your Cisco customer service representative immediately.

Upon receipt, inspect the equipment as follows:

Step 1 Take inventory.

Compare the equipment inside with the packing slip and the equipment list provided by customer service. If there are any discrepancies, notify the Customer Service Center.

Step 2 Check for external damage.

Visually check all components and immediately report any shipping damage to your customer service representative. Have the following information ready:

- Invoice number of shipper (see packing slip)
- Model and serial number of the damaged unit
- Description of damage
- Effect of damage on the installation

Maintaining a Network Record

Fill out all the required information in Appendix E, "Unit Maintenance and Network Record," so you will have a record of all of your hardware, configuration options, and network settings.

Mounting the System

The unit is designed for rack-mounting in a cabinet. We recommend mounting up to four units in one vertical rack and using chassis runners or telescopic slides. Use star-type lock washers on the rack screws to ensure a good conductive connection between the unit and the rack. For further information about installing the units in a customer cabinet, see the instructions from the cabinet manufacturer.

Caution Because of rack mounting, the plugs of the power cables on the rear side of the unit might not be accessible. Please provide a power circuit breaker to allow front power access. If you do not use a power circuit breaker, ensure quick access to the plug-socket combinations on the rear side of the unit at all times. In this case they serve as the main means of disconnecting.

Installing the System

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

To install, connect, and test the system, follow these steps:

Step 1 Unpack and inspect each unit. Verify completeness against the packing list.

Step 2 Fill out the form in Appendix E, "Unit Maintenance and Network Record."

Step 3 Mount each unit in a cabinet or a rack.

Step 4 Power up each unit.

Step 5 Run online tests as described in the "Running Online Tests" section on page 3-25.

Step 6 Connect the fiber-optic link between sites using the remote channel.

Step 7 Connect applications using the local channels.

Step 8 Test the system online to verify operation.

Note If a network element management interface (NEMI) is not installed, you have completed this portion of the installation tasks. If a NEMI is installed, refer to the *Cisco Metro 1500 Series Software Configuration Guide* and continue with Step 9.

Step 9 Connect to the serial port.

Step 10 Change default passwords. See Appendix E, "Unit Maintenance and Network Record."

Step 11 Log in as root and define network settings. See Appendix E, "Unit Maintenance and Network Record."

Step 12 Change the SNMP configuration.

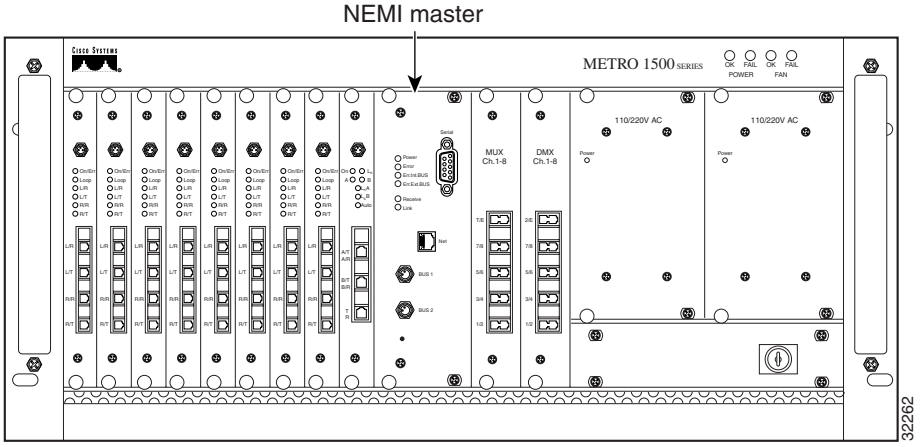
Step 13 Reboot the unit.

Installing the NEMI Module

To install a NEMI module (master and slave, as applicable), follow these steps:

Step 1 Remove the acrylic front cover from the unit in which the module should be added. (See Figure 3-1.)

Figure 3-1 NEMI Placement in the Primary Chassis and Extension Chassis B.



Step 2 Remove the two screws from the blank filler module. Remove the blank filler panels.

Step 3 Take the new module from the shipping container and use canned, dry, oil-free, compressed air to blow off any possible dust particles.

Step 4 Insert the NEMI module carefully into the chassis slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors.

Caution It is critical to insert the module gently. If you need a force greater than 1 lb (4.5 newton) to push in the module, stop immediately. Inspect the electrical connector. If the connector is not damaged, repeat Step 4.

Step 5 Hold the module in position after making full contact and use the two screws on the front panel of the module to secure it in the housing. When the module is in contact with the backplane, the green power LED is on.

Step 6 Reset the NEMI modules (both master and slave, if applicable) by inserting a pointed tool into the small hole on the front panel within the first 30 seconds of installation. The green power LED comes on and the NEMI module starts up.

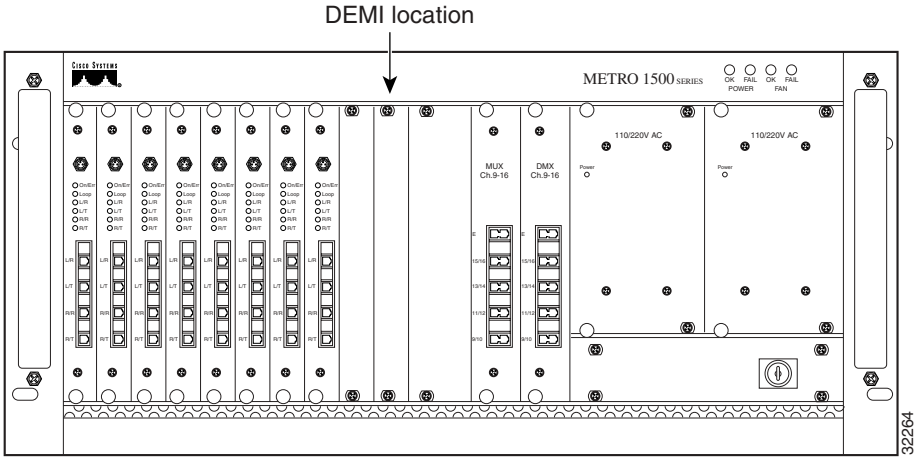
Step 7 Save the blank filler panels with the packaging material.

Installing the DEMI Module

To install a DEMI module, follow these steps:

Step 1 Remove the acrylic front cover from the unit in which the module should be added. (See Figure 3-2.)

Figure 3-2 DEMI Placement in Extension Chassis A and C



Step 2 Remove the two screws from the blank filler module. Remove the blank filler panel.

Step 3 Take the new module from the shipping container and use canned, dry, oil-free, compressed air to blow off any possible dust particles.

Step 4 Insert the DEMI module carefully into the chassis slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors.

Caution It is critical to insert the module gently. If you need a force greater than 1 lb (4.5 newton) to push in the module, stop immediately. Inspect the electrical connector. If the connector is not damaged, repeat Step 4.

Step 5 Hold the module in position after making full contact and use the two screws on the front panel of the module to secure it in the housing. When the module is in contact with the backplane, the green power LED is on.

Step 6 Save the blank filler panels with the packaging material.

Connecting Power

The system is equipped with two power supplies and two power cords. The power must be turned on by the power keyswitch on the AC-powered version only. The keyswitch is secured against rotation and the key can be removed in either the on or off position. A key for powering up the system is provided with each system.

When the power is on, all of the green power supply LEDs should be on for each power supply module (PSM) and wavelength channel module (WCM). The display panel provides important system information.

Warning **The plug-socket combination must be accessible at all times because it serves as the main disconnecting device.**

Warning **This unit might have more than one power cord. To reduce the risk of electric shock, disconnect the two power supply cords before servicing the unit.**

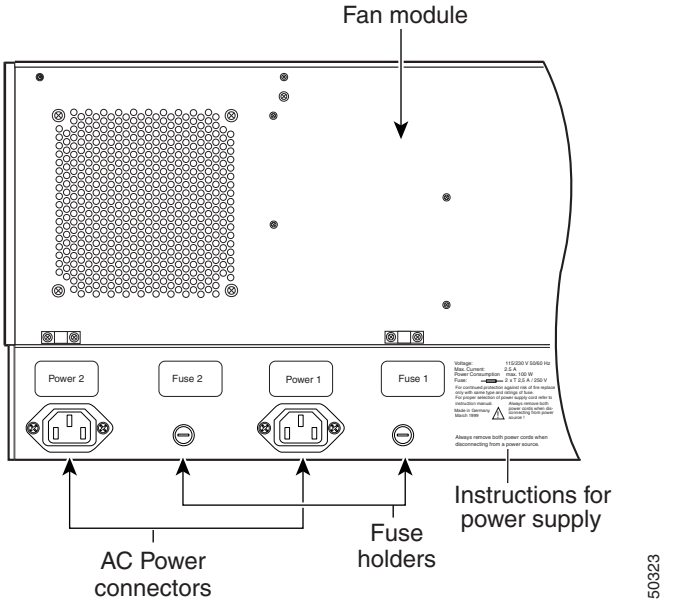
Caution Please use approved extension cords or a power circuit breaker to allow front power access.

Connecting AC Power

To connect AC power, follow these steps:

Step 1 Connect the power supply cords to power 1 and power 2 on the rear panel of the unit. (See Figure 3-3.)

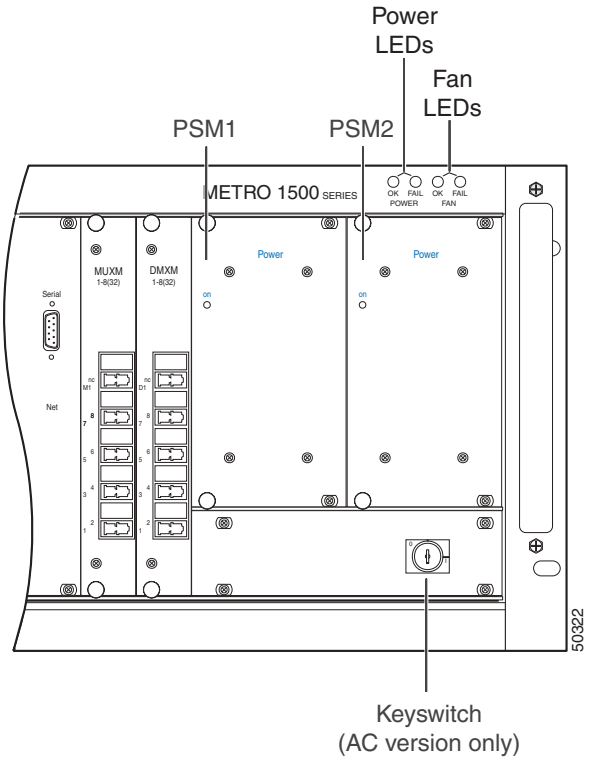
Figure 3-3 Rear Panel of the Cisco Metro 1500 (AC Version)



Step 2 Connect the ends of the power supply cords to the main power supply source.

Step 3 Turn the power on with the keyswitch at the front panel of the unit. (See Figure 3-4.)

Figure 3-4 Front Panel of the Cisco Metro 1500



The keyswitch is secured against rotation. The key can be removed in either the (0) or (|) position. A pair of keys for powering up is supplied with each system.

Warm up the unit for 30 minutes before testing the laser power or connecting applications.

Caution If powered down, wait at least 10 seconds before you switch the unit on again.

Connecting DC Power

The system is equipped with two PSMs and two DC power cables. There are two DC powered versions of the Cisco Metro 1500 Series. The European DC version uses the DC plug-socket conbination. The US version uses terminal blocks. Depending on the type of connectors on the power distribution unit (PDU), you have to use the power cables for SELV applications or the power cables for all other centralized 48-VDC applications.

Installing Terminal Blocks (US Version)

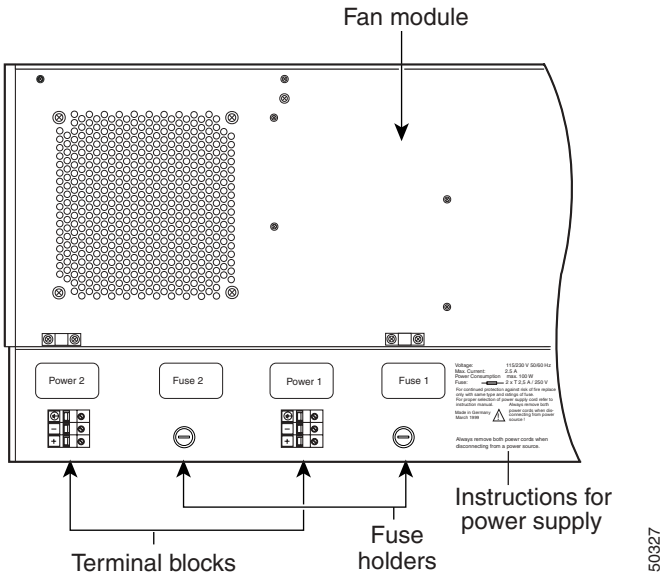
The Cisco Metro 1500 series system is equipped with two PSMs. To connect the system to the PDU, you need two approved three-core interconnection cables.

To connect the power cables for the US version, follow these steps:

Step 1 Remove the insulation of each wire on both ends of the interconnection cables at a length of about 5 mm.

Step 2 Connect the wires of the cables to the terminal blocks in the rear panel of the unit. (See Figure 3-5.)

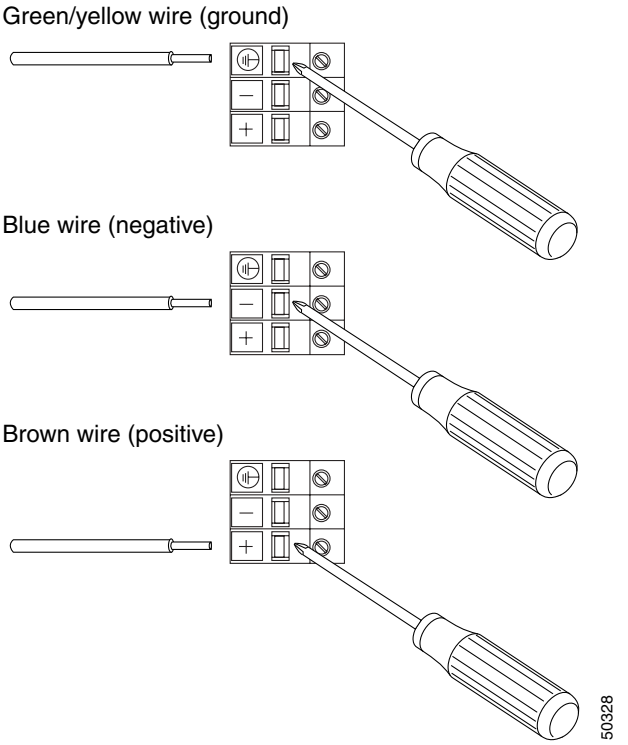
Figure 3-5 Rear Panel of the PSM (US Version)



Caution Do not use damaged terminal blocks. Immediately replace damaged or defective terminal blocks

Step 3 Take a medium screwdriver and push it into the rectangular hole of the terminal block. (See Figure 3-6.) At the same time, slide the insulation-free end of the wire into the respective rectangular hole at the bottom of the power clamp. Repeat this step for the other wires.

Figure 3-6 Connecting Wires



Step 4 Connect the three wires on the other end to the corresponding high current connectors of the power distribution unit. Attach the wires to their respective points in the connectors.

Caution Make sure that the three wires of the power cables are correctly fixed at the clamps of the PDU connectors.

Caution Never connect blue (negative) or brown (positive) wires to the ground pin.

Step 5 Turn the power on using the corresponding power switch of the PDU.

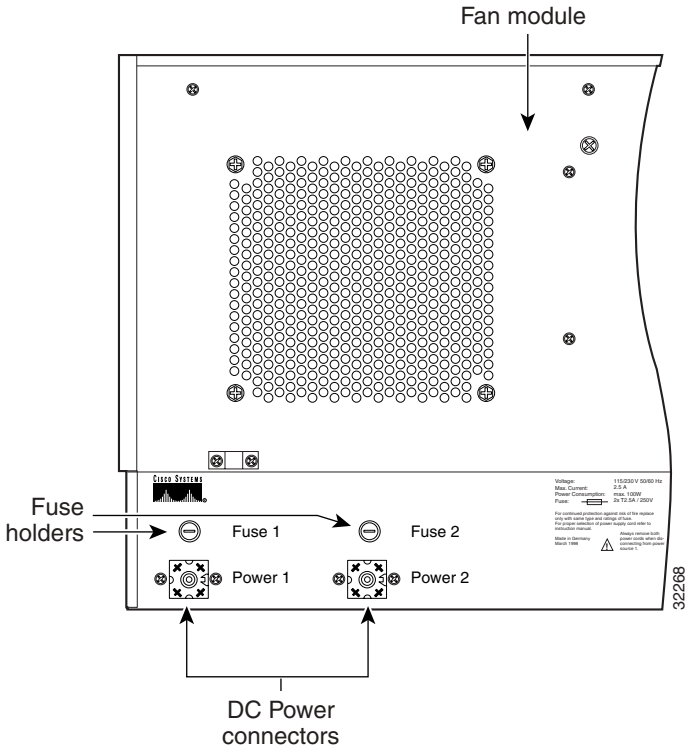
The chassis powers up as soon as the corresponding power switch of the PDU is turned on.

Installing the DC Plug-Socket Combination (European Version)

To connect the power cables for the European version, follow these steps:

Step 1 Connect the desired power cables to power 1 and power 2 on the rear panel of the Cisco Metro 1500 series system and attach the plugs with the screws to the sockets. (See Figure 3-7.)

Figure 3-7 Rear Panel of the Cisco Metro 1500 (DC Version)

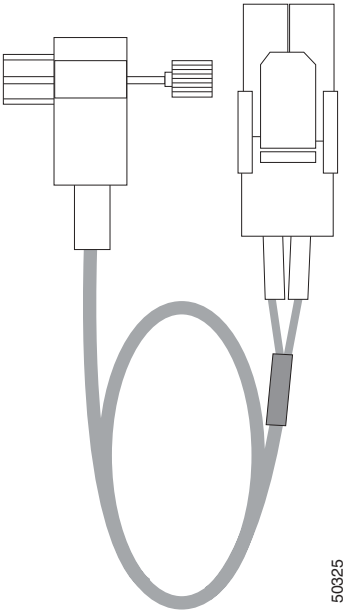


Caution Tighten the screw of the plug to avoid loss of connection.

Step 2 Choose the appropriate power cable.

Step 3 Connect the plug (the power cable for the SELV application is fitted with a special plug) to the corresponding connector of the PDU. (See Figure 3-8.)

Figure 3-8 SELV Application Power Cable

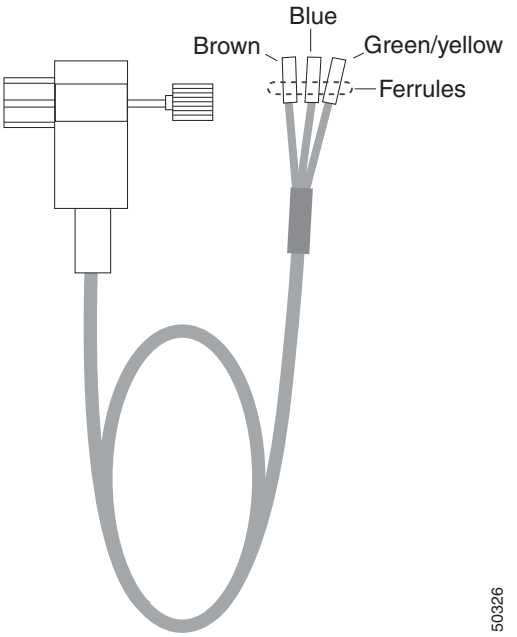


Step 4 Attach the three wires to their respective points in the corresponding connectors of the PDU as described as follows:

Brown wire	life	+
Blue wire	neutral	-
Green/ Yellow wire	ground	PE

The power cable for the 48 VDC application has wire ferrules on the other end. (See Figure 3-9.)

Figure 3-9 48 VDC Application Power Cable



Caution Make sure that the three wires on the power cables are correctly fixed at the terminal clamps of the unit and at the connectors of the PDU.

Warning **This warning applies only to units equipped with DC input power supplies. Wire the DC power supply using the appropriate lugs at the wiring end. The proper wiring sequence is ground to ground, positive to positive (line to L), and negative to negative (neutral to N). Note that the ground wire should always be connected first and disconnected last.**

Step 5 Turn the power on using the corresponding power switch of the PDU.

The chassis powers up as soon as the corresponding power switch of the PDU is turned on. If the DC power cables are not connected to the PDU, the plug socket combinations on the rear end of the unit serve as switches.

Power Consumption and Power Supply Fuses

The system power consumption is less than 150 W.

Use the following fuses:

Power Type	Fuse Type	No. of Fuses
AC version	2.5A at 250V, slow blow, 5 x 20 mm	2
DC version	6.3A at 250V, slow blow, 5 x 20 mm	2

Caution Always replace blown fuses with fuses of the same type and size.

Caution Do not use damaged terminal blocks. Immediately replace damaged or defective terminal blocks.

Note The 115/230V version automatically detects the input voltage. No further adjustment is necessary.

The Cisco Metro 1500 series system supports the following power sources:

AC	110 to 240V, 50 or 60 Hz
DC	-48 to -60V

Table 3-1 lists the power requirements in different countries.

Table 3-1 Power Requirements

Region	Power Requirements
North America	110 to 120 VAC, 60 Hz or -48 to -60 VDC
Europe	210 to 240 VAC, 50 Hz or -48 to -60 VDC

Grounding the Chassis

Connecting the power cords to the chassis provides basic grounding. You should also connect a separate grounding cable for each chassis to the rack. Use the ground contact on the right side of the chassis to make the grounding connection.

To ground the chassis, follow these steps:

Step 1 Connect a wire to the earth contact on the right side of the chassis.

Step 2 Connect the other end of the wire to the rack.

Cleaning the System

This section describes how to clean the chassis and the connectors and includes the following sections:

- Cleaning the Chassis
- Cleaning the Connectors

Cleaning the Chassis

Be very careful with the air flow system when you clean the chassis. If the cleaning process has to be done while the system is on, be aware that the airflow system is in operation. Clean the chassis with a damp cloth only and be careful of the following:

- Do not touch the safety lattice of the airflow system while fans are operating.
- Do not use wet tissues for cleaning the product's outer housing.
- Do not use any harsh or abrasive cleaning agents.

Cleaning the Connectors

Fiber optic connectors are used to connect two fibers together. When these connectors are used in a communication system, proper connection becomes a critical factor.

Fiber optic cable connectors can be damaged by improper cleaning and connection procedures. Dirty or damaged fiber optic connectors can result in not repeatable or inaccurate communication.

Fiber optic connectors differ from electrical or microwave connectors. In a fiber optic system, light is transmitted through an extremely small fiber core. Because fiber cores are often 62.5 microns or less in diameter, and dust particles range from a tenth of a micron to several microns in diameter, dust and any contamination at the end of the fiber core can degrade the performance of the connector interface where the two cores meet. Therefore, the connector must be precisely aligned and the connector interface must be absolutely free of trapped foreign material.

Connector, or insertion, loss is a critical performance characteristic of a fiber optic connector. Return loss is also an important factor. It specifies the amount of reflected light; the lower the reflection the better the connection. The best physical contact connectors have return losses better than -40 dB, although -20 to -30 dB is more common.

The connection quality depends on two factors; the type of connector and the proper cleaning and connection techniques.Dirty fiber connectors are a common source of light loss. Keep the connectors clean at all times and keep the dust cover installed when not in use.

Before installing any type of cable or connector, use a lint-free alcohol pad from a cleaning kit to clean the ferrule, the protective white tube around the fiber, and the end-face surface of the fiber.

As a general rule, whenever there is a significant, unexplained loss of light, clean the connectors.

Caution Use extreme care when removing or installing connectors so you do not damage the connector housing or scratch the end-face surface of the fiber. Always install protective covers on unused or disconnected components to prevent contamination. Always clean fiber connectors before installing them.

Use a swab saturated with isopropyl alcohol to clean the end-surfaces. Use dry, oil-free compressed air after applying the isopropyl alcohol.

To clean the optical connectors, follow these steps:

Step 1 Gently wipe the ferrules and end-face surfaces of the connector with an alcohol pad from the cleaning kit. Be sure that the pad makes full contact with the end-face surfaces. Wait five seconds for the surfaces to dry and repeat.

Step 2 Blow dry the connectors with canned, dry, oil-free, compressed air.

Step 3 Use a magnifying glass to inspect the ferrule.

The connectors used inside the system have been cleaned by the manufacturer and connected to the adapters in the proper manner. The operation of the system should be error free if the customer provides clean connectors on the application side, follows the previous directions and ensures the following:

- Clean the connectors using lens tissues before connecting to the adapters. Use pure alcohol to remove soil.
- Do not clean the inside of the connector adapters.
- Do not use force or quick movements when connecting the fiber optic connectors in the adapters.

- Cover the connector adapters to avoid soiling or contaminating the inside of the adapters while cleaning the chassis.
- Cover the connectors and adapters to avoid the inside of the adapters or the surface of the connectors from getting dirty when not using the connectors.

Note If the surface is not clean or does not have a uniform shine, repeat the process using a fresh surface of the alcohol pad.

Removing the Power Supply Module

This section describes how to power on the system, determine whether a power supply module (PSM) is faulty, and how to replace a PSM, if necessary.

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

The Cisco Metro 1500 series system has two identical, fully redundant PSMs. Each PSM can cover the power needs of the entire system. These PSMs provide 5V and 30A to the system. The PSM provides full input-to-output, input-to-case, and output-to-output isolation.

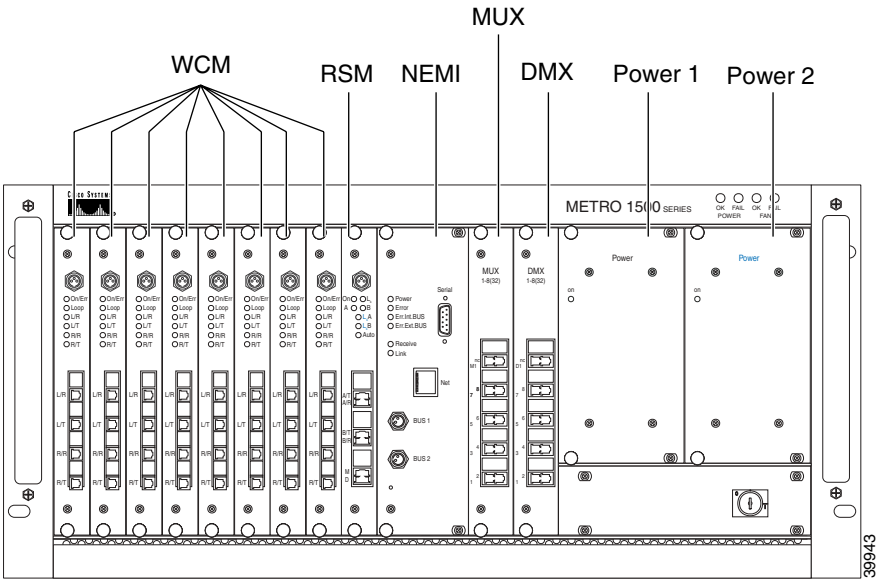
Power On/Off

Caution If powered off, wait at least 10 seconds before you switch the unit on again.

Turn the power on or off using the keyswitch on the AC-powered version only. (See Figure 3-10.) This switch supplies power to the redundant power supplies. You can only move the switch to the on (|) or off (0) position. Two keys are shipped with each unit and all units use the same key. You can remove the key in either the on or off position.

The display on the front panel of the chassis indicates whether the power is on or off. You can also monitor power status from the NEMI. For more information about monitoring the power supply from the NEMI, refer to the *Cisco Metro 1500 series Software Configuration Guide*.

Figure 3-10 Power Supply Modules



Determining Power Supply Status

If the LED on a power supply is off while the unit is powered on, and the power cable is plugged in the corresponding power socket, then either the cable is faulty, a fuse has blown, or the power supply itself has failed. To determine the possible cause of the failure, follow these steps:

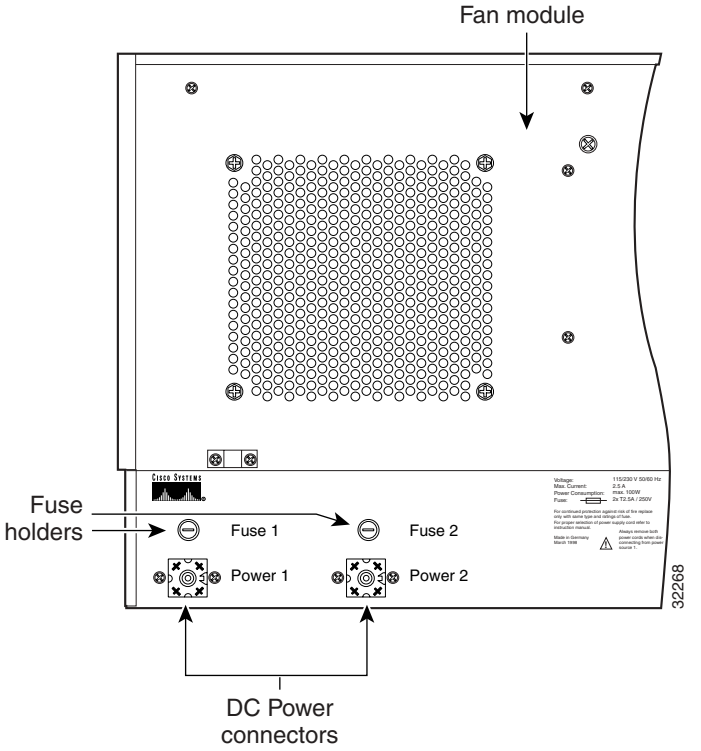
Step 1 Check the power cable to make sure that it is securely plugged into the unit. If the cable is correctly attached, go to Step 2.

Step 2 Check the fuses by disconnecting the power cord and opening the fuse holder. If the fuses are okay, swap out the failed power supply module.

Note Check and replace the failed unit as soon as possible.While you replace the faulty power supply, the redundant power supply continues to provide uninterrupted service.

Note The power socket labeled Power 1 supplies current to the left power supply (Power 1). See Figure 3-11. The power socket labeled Power 2 supplies current to the right power supply (Power 2).

Figure 3-11 Rear View of Power Supply Module



All PSMs are hot-swappable and can be replaced while the system is in service. To replace a PSM, follow these steps:

Step 1 Remove the power cord associated with the failed power supply and loosen the four panel screws.

Step 2 Pull out the malfunctioning module.

Step 3 Slide in the spare module.

Step 4 Check that the green LED is on.

Step 5 Reconnect the power cord.

Step 6 Tighten the four panel screws.

Running Online Tests

Note The power levels cannot be checked without special measurement equipment because of the automatic laser shutdown (ALS). All power measurements must be done in-line because of ALS.

System checkout and online testing are usually performed during working hours. Be sure to coordinate these tasks with the Cisco authorized representative.

Online testing varies from site to site depending on the CPU, operating systems in use, and the local channels being connected.

Be sure to set up and run your test jobs before installing the unit. Test jobs must be set up and verified by the customer prior to the actual installation of the system. For test purposes, you can force the laser on by means of the network management system as described in the *Cisco Metro 1500 Series Software Configuration Guide*.

Note If your test results of the remote link deviate from the results described in these steps and you cannot correct the problem, contact your service representative.

Verifying Connections

Although the optical side of the Cisco Metro 1500 series system is designed to be plug and play, it is common practice to verify input and output levels for the optical interfaces existing in a typical connection because optical connections are susceptible to dust and optical cables can be ruined by physical abuse.

Budget measurements should be carried out at points A and F to check whether the user equipment is correctly interfaced. The budget measurement at point A should be within the range specified on the Cisco Metro 1500 series label. Measurement at point E is required to check whether the attenuation over the long distance is within the power budget. Budget measurements at point C and point D, measured at the remote side, can be used to calculate loss-levels of the connecting fiber line. All channel modules leaving the factory are accompanied by a test report.

Measuring Channel Outputs and Channel Budgets

Channel module outputs, measured at entry to the MUX, point B, or exit of the DMX, point E, are practically constant for all channel cards, whereas measurements at the exit of the BSM (point C) or entry to the BSM (point D) can exhibit a variation of 0 to 2 dB.

Note All power measurements must be done in-line because of ALS.

All measurements concerning budgets need modulated light. We recommend using an external modulated light source. Practically any low powered light source with roughly 100 MHz modulation can be used. If a need for an approved light source exists, contact your Cisco representative.

You need:

- A Cisco Metro 1500 series system
- Access to two Cisco Metro 1500 series systems under test already connected through optical fibers and RSMs (or fiber spools) depending on system configuration
- A short fiber jumper
- Access to ocmstate
- An optical power meter connected in-line through an optical coupler or an optical in-line power meter

If you have an external 100-MHz modulated light source, follow Steps 1 to 3 to measure channel output at point F:

Step 1 Pick a pair of channel modules preferably without clock (or with a clock that can be disabled with the ocmstate command, since none of the currently delivered clocks will match).

Step 2 Connect the light source output to the connector labeled L/R (local receiver) of the local channel module. As a result, the green LED of the local receiver of the channel module is on and the ALS starts working (every 10 seconds the LED for remote transmitting blinks shortly). However, the signal does not get looped back yet.

Step 3 Use the ocmstate command to switch on the local loop. Now you can measure the output power at point F. Afterwards, switch off the local loop. To measure at points B or C, follow Steps 1 and 2 and then Step 4:

Step 4 Use the ocmstate command to switch the remote laser to “forced ON” to overcome ALS. Then measure at points B and C. If you want to measure the input at points D or E, follow Steps 1, 2, and 3 and then Step 5.

Step 5 Use ocmstate to activate the remote loopback on the remote side of the link.

The link comes up. All lasers and receivers at the channel module are on and the remote receiver and the remote transmitter at the channel module on the remote side of the link are on. The local transmitter at the channel module at the remote side of the link is also on to allow measurements.

In case you do not have an adequate external modulated light source, you can use the modulated light (100 MHz) of the pilot laser of the Cisco Metro 1500 series system’s RSM (only an option if your Cisco Metro 1500 series system is equipped with an RSM). In this case, in Step 2 you connect the local RSMs B/R (output of the pilot laser) to the connector labeled L/R (local receiver) of the channel module. The output of the pilot laser is sent against traffic.

Note Do not forget to set or enable clocks, disable loopback and enable automatic mode for the RSM before putting the Cisco Metro 1500 series units into service.

Troubleshooting

If trouble occurs during installation, check Table 3-2 for a list of troubleshooting tips. If the solution is not in the table, contact your Cisco service representative.

Table 3-2 Troubleshooting Tips

Problem	Probable Cause	Solution
No power	No power is coming from the outlet.	Turn on power.
	Power cables are loose.	Check and reseat cables.
	Power supply modules are not engaged.	Fully engage modules.
Power alarm	No power is coming from one outlet.	Turn on power.
	One power cable is loose.	Check and reseat cables.
	Power supply fuse is blown.	Check and replace fuse.
Not receiving local data	Local channel is not online.	Place local channel online.
	Fiber-optic connectors are loose.	Check and reseat connectors.
	Tx-Rx connectors are not matched.	Switch Tx-Rx connectors.
	Connectors are dirty or blown.	Clean or replace connectors.
	Local cables are not properly seated.	Trace and properly connect cables.
	Local link power exceeds budget.	Troubleshoot and retest local link.
	Channel card is not connected.	Connect all required optical fiber cables to the channel card.
	Fiber links are dirty or blown.	Clean or replace fiber cables.

Table 3-2 Troubleshooting Tips (continued)

Problem	Probable Cause	Solution
Not receiving remote data	Fiber-optic connectors are loose.	Check and reseat connectors.
	Tx-Rx connectors are not matched.	Switch Tx-Rx connectors.
	Remote cables are not properly seated.	Trace and properly connect cable.
	Remote link power exceeds budget.	Troubleshoot and retest remote link.
	Channel card is not connected.	Connect all required optical fiber cables to the channel card.
	Fiber links are dirty or blown.	Clean or replace fiber cables.
Inactive line is not in standby mode	Link is not connected.	Connect all required optical fiber cables of the line to the channel card.
	Remote link power exceeds budget.	Troubleshoot and retest remote link.
	Fiber links are dirty or blown.	Clean or replace fiber cables.
No password prompt after entering a proper login name	A non-supported adapter is being used to connect to the Cisco Metro 1500 series serial port.	Use the supplied DB-9 to RJ-45 adapter or an adapter that includes DCD/DTR[1] flow control and RTS/CTS[2] flow control.

1. DCD/DTR = data carrier detect/data terminal ready
2. RTS/CTS = request to send/clear to send

CHAPTER 4

Installing the Modules

This chapter describes how to install modules in the Cisco Metro 1500 series system. The modules are installed and removed using the same basic steps. This chapter includes the following sections:

- Before Installing the Modules, page 4-2
- Adding and Replacing Modules, page 4-2

The Cisco Metro 1500 series system can be equipped with the following modules, which are described in Chapter 1, "Product Overview."

Modules	Section Name and Page Number
WCMs	Wavelength Channel Modules, page 1-16
MUX and DMX	Multiplexer and Demultiplexer Modules, page 1-22
BSM	Band Splitter Module, page 1-24
RSM	Remote Switch Module, page 1-26
TDM4E	TDM4E Wavelength Channel Modules, page 1-31

Note For information on connecting the modules after they have been installed, see Chapter 5, "Connecting Optical Cables."

Before Installing the Modules

Before installing the modules, see Chapter 2, "Preparing for Installation." Also note the following warnings:

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.**

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

The following tools are required for installing modules in the chassis:

- Number 1 and number 2 Phillips screwdrivers
- Small flat-blade screwdriver
- Wrist strap or other personal grounding device

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.**

Adding and Replacing Modules

This section describes how to add and replace modules without interrupting unit operation.

Note Before connecting the fiber cable, remove the dust covers and blind plugs, and clean the fiber ferrules. The minimum bend radius of optical fiber cables is about 30 to 50 nm. Avoid tightening or pressuring fibers.

Installing Modules

To install modules, follow these steps:

Step 1 Remove the acrylic front cover from the unit in which the module should be added or in which a WCM should be replaced.

Step 2 Remove the two screws from the blank filler module and remove the module.

Step 3 Take the new module from the shipping container and use canned, dry, oil-free, compressed air to blow off any possible dust particles.

Step 4 Insert the module carefully into the chassis slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors.

Caution It is critical to insert the module gently. If you need a force greater than 1 lb (4.5 newton) to push in the module, stop immediately. Inspect the module and the electrical connector. If the module or connector is not damaged, repeat Step 4.

Step 5 Hold the module in position after making full contact and use the two screws on the front panel of the module to secure it in the housing. When the module is in contact with the backplane, the power LED turns green.

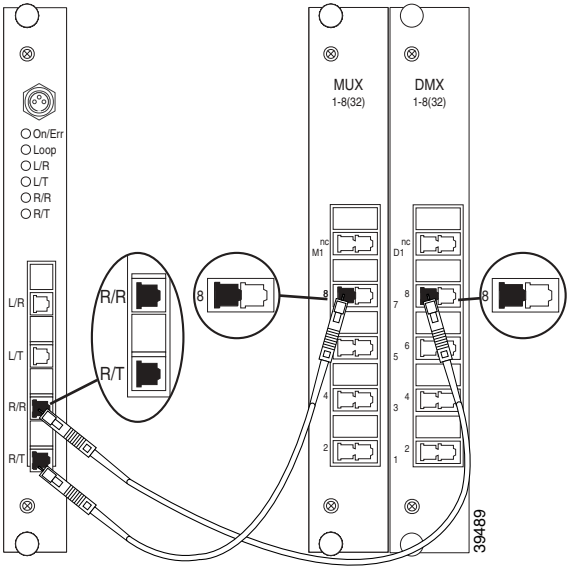
Note The red LED flashes during the initialization process.

Step 6 Connect a MiniSC jumper to the WCM labeled R/T.

Step 7 Connect the other end of the jumper to the corresponding connector of the MUX. For example, if you interconnect the seventh WCM, use the MUX connector labeled 7, as shown in Figure 4-1.

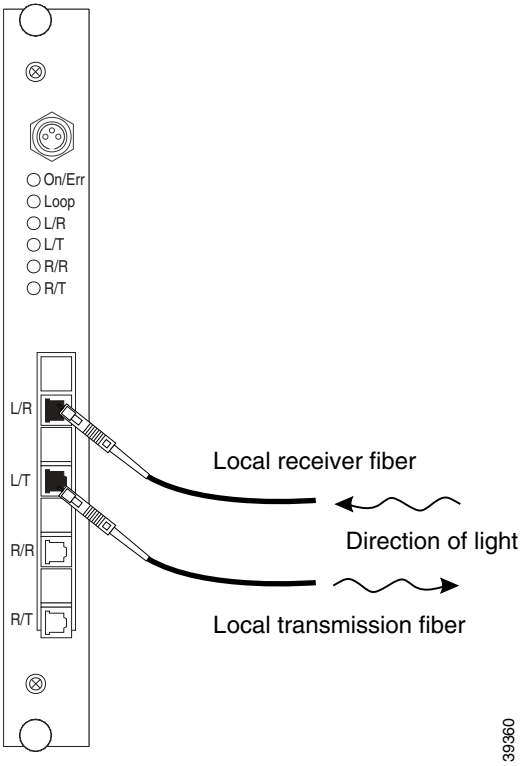
Note The DMX in Figure 4-1 is shown for reference only.

Figure 4-1 Connecting a WCM to a MUX



Step 8 Connect the MiniSC plug of the local receiver fiber line to the WCM labeled L/R, as shown in Figure 4-2.

Figure 4-2 Connecting Local Lines to a WCM



Step 9 Connect the MiniSC plug of the local transmission fiber line to the WCM labeled L/T, as shown in Figure 4-2.

Step 10 Place the fiber-optic cables in the cable holder of the chassis and the rack at the side of the chassis.

Step 11 Mount the acrylic cover on the front of the chassis.

Step 12 Save the blank filler panel with the packaging material.

If you applied a local signal to the added channel, the green L/R LED and green R/T LED should both be on.

When the remote lines from the DMX to the MUX are also connected, the remote transmitter light is fed from the other Cisco Metro 1500 series chassis, and the green R/R LED of the active line and green L/T LED should both be on.

Note If you have any problems with the installation, contact your Cisco service representative immediately.

Removing a Module

To remove a module from your unit without interrupting system operation, follow these steps:

Step 1 Remove the acrylic front cover of the unit from which the module should be removed.

Step 2 Remove all jumpers from the desired module and install appropriate dust covers on the fiber cable connectors and the blind plugs into the module connectors.

Step 3 Remove the remote line jumpers from the desired MUX and DMX connectors. Install appropriate dust covers on the fiber cable connectors and the plugs into the MUX and DMX connectors.

Step 4 Remove the two screws that connect the protective front panel of the desired module to the chassis.

Step 5 Remove the module carefully.

Step 6 Reinstall the blank filler module.

Step 7 Place the removed module in a container appropriate for shipping and storage.

Step 8 Mount the acrylic cover on the front of the chassis.

CHAPTER 5

Connecting Optical Cables

This chapter describes how to connect the optical cables for the Cisco Metro 1500 series system. It includes the following sections:

Caution Make sure that there is no danger that the cables may inadvertently be pulled or cause anyone to trip when in use.

Note Ports connecting to the user use multimode, single-mode, or a combination of both types of cables depending on the application. Ports on the MUX or DMX use single-mode cables only.

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

Note Remove dust covers and blind plugs immediately before you connect the fiber cable.

Note Clean the fiber ferrules as described in the "Cleaning the System" section on page 3-18. Use canned, dry oil-free compressed air only.

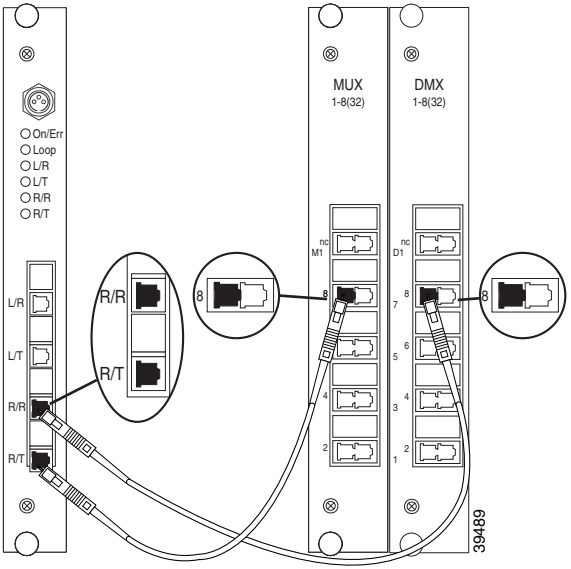
Connecting WCMs to MUX and DMX Modules

To connect a WCM to MUX and DMX modules, follow these steps:

Step 1 Remove the dust cover from one end of a jumper and the blind plug from the WCM connector labeled R/T (remote transmitter). Connect the MiniSC plug to the open connector.

Step 2 Remove the dust cover from the other end of the jumper and the blind plug from the corresponding MUX connector. For example, if you interconnect the seventh WCM, remove the blind plug from the MUX connector labeled 7. (See Figure 5-1.)

Figure 5-1 Connecting a WCM to a MUX and a DMX



Step 3 Remove the blind plug from the WCM connector labeled R/R (remote receiver) and the dust cover from one end of a short jumper. Connect the MiniSC plug to the open connector.

Step 4 Remove the dust cover from the other end of the jumper and the blind plug from the corresponding DMX connector. For example, if you interconnect the seventh WCM, remove the blind plug from the DMX connector labeled 7. (See Figure 5-1.)

Step 5 Place the fiber-optic cables in the cable holder at the bottom of the chassis.

Repeat these steps with all other WCMs of the main chassis and extension chassis.

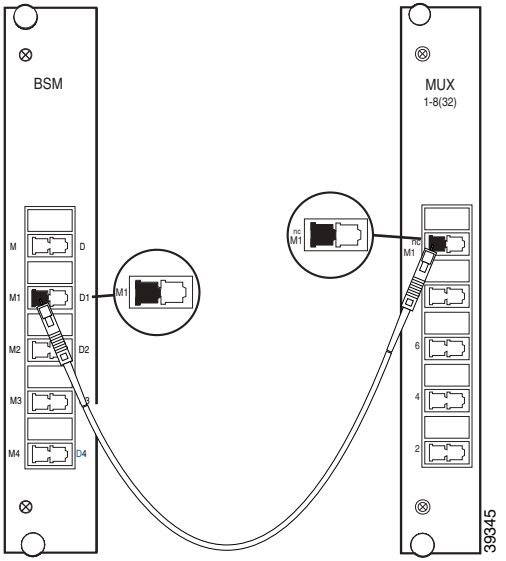
Connecting BSMs with MUX and DMX Modules

To connect a BSM to MUX and DMX modules, follow these steps:

Step 1 Remove the dust cover from one end of a jumper and the blind plug from the MUX connector labeled M1. (Use M1 if you are routing the MUX of the primary chassis.) Connect the MiniSC plug to the open connector.

Step 2 Remove the dust cover from the other end of the jumper and the blind plug from the BSM connector labeled M1. (Use M1 if you are routing the MUX of the primary chassis.) Connect the MiniSC plug to the open connector of the BSM, as shown in Figure 5-2.

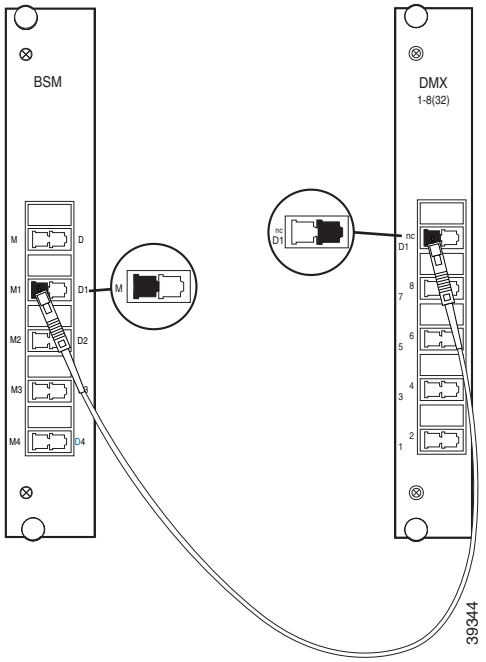
Figure 5-2 Connecting a BSM to a MUX



Step 3 Remove the dust cover from one end of a jumper and the blind plug from the DMX connector labeled D1. (Use D1 if you are routing the DMX of the primary chassis.) Connect the MiniSC plug to the open connector.

Step 4 Remove the dust cover from the other end of the jumper and the blind plug from the BSM connector labeled D1. (Use D1 if you are routing the DMX of the primary chassis.) Connect the MiniSC plug to the open connector of the BSM, as shown in Figure 5-3.

Figure 5-3 Connecting a BSM to a DMX



Step 5 Place the fiber-optic cables in the cable holder of the primary and extension chassis and the rack at the side of both chassis.

Note If you have an RSM installed, proceed to the "Connecting a BSM to an RSM" section on page 5-6. Otherwise skip to the "Connecting Remote Lines to a BSM" section on page 5-7

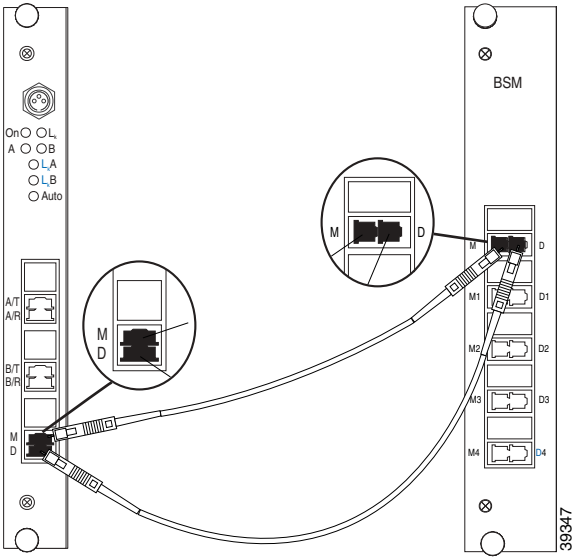
Connecting a BSM to an RSM

To connect a BSM to an optional RSM, follow these steps:

Step 1 Remove the dust cover from one end of a jumper and the blind plug from the BSM connector labeled M. Connect the MiniSC plug to the open connector.

Step 2 Remove the dust cover from the other end of the blind plug from the RSM connector labeled M. Connect the MiniSC plug to the open connector of the RSM, as shown in Figure 5-4.

Figure 5-4 Connecting a BSM to an RSM



Step 3 Remove the dust cover from one end of a jumper and the blind plug from the BSM connector labeled D. Connect the MiniSC plug to the open connector.

Step 4 Remove the dust cover from the other end of the jumper and the blind plug from the RSM labeled D. Connect the plug to the open connector of the RSM, as shown in Figure 5-4.

Step 5 Place the fiber-optic cables in the cable holder of the primary and extension chassis and the rack at the side of both chassis.

Note If you have a BSM installed, proceed to the "Connecting Remote Lines to a BSM" section on page 5-7. Otherwise skip to the "Connecting Remote Lines to RSMs" section on page 5-9.

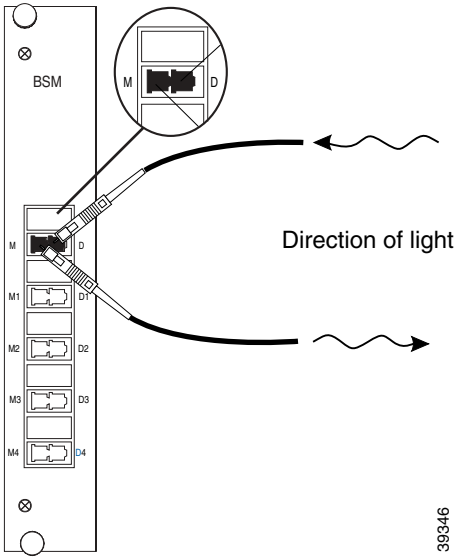
Connecting Remote Lines to a BSM

To connect remote lines to a BSM, follow these steps:

Step 1 Remove the dust cover from the MiniSC plug of the remote transmission fiber of line A, and clean the fiber as described in "Cleaning the Connectors" section on page 3-19.

Step 2 Remove the blind plug from the BSM connector labeled M. Connect the cleaned plug to the open connector of the BSM. (See Figure 5-5.)

Figure 5-5 Connecting Remote Lines to a BSM



Step 3 Remove the dust cover from the MiniSC plug of the remote receiver fiber line, and clean the fiber as described in the "Cleaning the Connectors" section on page 3-19.

Step 4 Remove the blind plug from the BSM connector labeled D. Connect the cleaned plug to the open connector of the BSM, as shown in Figure 5-5.

Step 5 Place the fiber-optic cables in the cable holder of the primary and extension chassis and the rack at the side of both chassis.

Note If you have an optional RSM installed, proceed to the "Connecting Remote Lines to RSMs" section on page 5-9. Otherwise skip to the "Connecting Local Lines to WCMs" section on page 5-10.

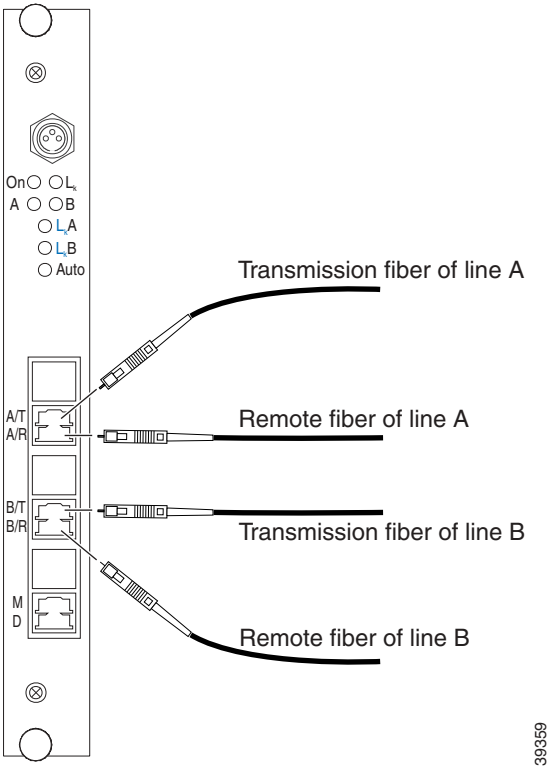
Connecting Remote Lines to RSMs

To connect remote lines to an RSM, follow these steps:

Step 1 Remove the dust cover from the MiniSC plug of the remote transmission fiber of line A, and clean the fiber as described in "Cleaning the Connectors" section on page 3-19.

Step 2 Remove the blind plug from the RSM connector labeled A/T. Connect the cleaned plug to the open connector of the RSM, as shown in Figure 5-6.

Figure 5-6 Connecting Remote Lines to an RSM



Step 3 Remove the dust cover from the MiniSC plug of the remote receiver fiber of line A, and clean the fiber as described in "Cleaning the Connectors" section on page 3-19.

Step 4 Remove the blind plug from the RSM connector labeled A/R. Connect the cleaned plug to the open connector of the RSM. (See Figure 5-6.)

Step 5 Remove the dust cover from the MiniSC plug of the remote transmission fiber of line B, and clean the fiber as described in "Cleaning the Connectors" section on page 3-19.

Step 6 Remove the blind plug from the RSM connector labeled B/T. Connect the cleaned plug to the open connector of the RSM. (See Figure 5-6.)

Step 7 Remove the dust cover from the MiniSC plug of the remote receiver fiber of line B, and clean the fiber as described in "Cleaning the Connectors" section on page 3-19.

Step 8 Remove the blind plug from the RSM connector labeled B/R. Connect the cleaned plug to the open connector of the RSM. (See Figure 5-6.)

Step 9 Place the fiber-optic cables in the cable holder of the primary and extension chassis and the rack at the side of both chassis.

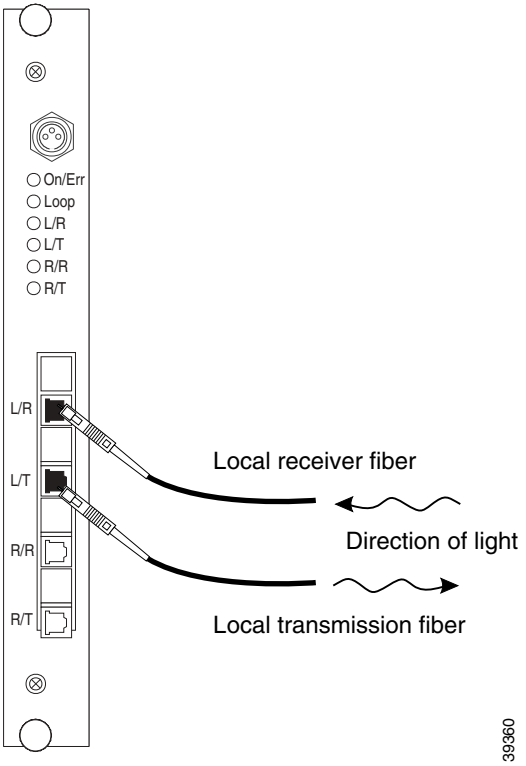
Connecting Local Lines to WCMs

To connect local lines to a WCM, follow these steps:

Step 1 Remove the dust cover from the MiniSC plug of the local receiver fiber and clean the fiber as described in "Cleaning the Connectors" section on page 3-19.

Step 2 Remove the blind plug from the WCM connector labeled L/R. Connect the cleaned plug to the open connector of the WCM. (See Figure 5-7.)

Figure 5-7 Connecting Local Lines to a WCM



Step 3 Remove the dust cover from the MiniSC plug of the local transmission fiber and clean the fiber as described in "Cleaning the Connectors" section on page 3-19.

Step 4 Remove the blind plug from the WCM connector labeled L/T. Connect the cleaned plug to the open connector of the WCM, as shown in Figure 5-7.

Step 5 Place the fiber-optic cables in the cable holder of the primary chassis and extension chassis and the rack at the side of both chassis.

Step 6 Mount the acrylic cover on the front of the chassis.

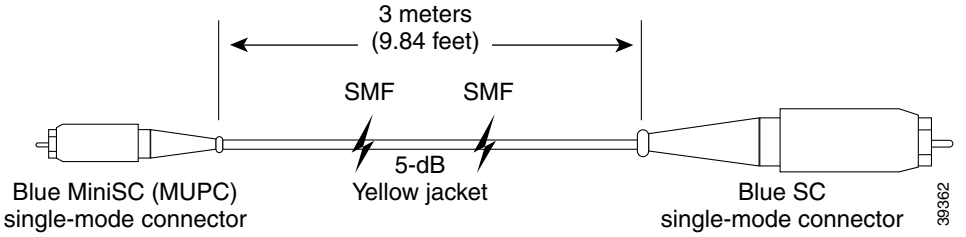
Connecting Fiber Channel or Gigabit Ethernet to a High-Speed Transparent WCM

When connecting a fiber channel or Gigabit Ethernet port to a high-speed transparent WCM on the Cisco Metro 1500 series system, you must ensure that the optical power levels from the fiber channel or Gigabit Ethernet transmitter do not overdrive the local receiver (L/R) port on the WCM. To avoid an overdrive condition, insert an optical attenuation of 5 dB between the fiber channel or Gigabit Ethernet transmitter and the L/R port on the WCM. You can implement this attenuation with either an attenuating single-mode patch cable assembly or an attenuating coupler, which are described in the following sections.

Attenuating Single-Mode Patch Cable

An attenuating single-mode patch cable is a 9.84-ft (3 m) fiber-optic jumper cable with a built-in attenuation of 5 db. (See Figure 5-8.)

Figure 5-8 Attenuating Single Mode Patch Cable Assembly



The attenuating single-mode patch cable assembly should contain Corning SMF-28 or equivalent single-mode fiber.

Attenuating Coupler

As an alternative to the attenuating single-mode patch cable, you can use a 5-dB attenuating coupler. (See Figure 5-9.)

Figure 5-9 Attenuating Coupler

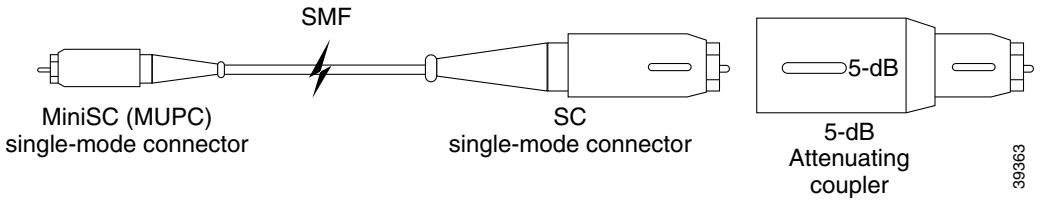


Figure 5-9 shows a conventional MiniSC to SC patch cable, plus the attenuating coupler, which achieves the same effect as the attenuating single-mode patch cable assembly with the built-in attenuation.

Other Limitations and Restrictions

The following limitations and restrictions for connecting fiber channel or Gigabit Ethernet to a high-speed transparent WCM:

- The coupling facility currently requires that at least two LPARs be active for the link to activate and that the link between the two sites be no longer than 15.5 mi (25 km). Installation of the card requires that an LPAR be cycled to clear the loop condition created by the card. If only one LPAR is present, the optical interface is cycled with the LPAR and the loop is once again established.
- When using low-speed applications (200 Mbps and below) with high-speed cards, the application is typically overdriven. As a workaround, add attenuation to the signal coming from the local transmitter port of the Cisco Metro 1500 series system.
- Do not use a multimode patch cable that has been attenuated using core-shifted splicing to attenuate the signal coming from a Cisco Metro 1500 series system. The system interface is always a single-mode laser and the attenuation is not consistent or reliable. In addition, for all interfaces, avoid air-gap attenuators, which have high back reflection that may cause bit errors on the connection.

Caution When connecting Cisco Metro 1500 series systems, you must adhere to the minimum remote link budget, as called out in Table A-9 on page A-15. If you do not adhere to this minimum budget, you might damage the receivers of the channel cards. This damage can only be repaired at the factory and is not covered by the warranty.

Connecting Optical Isolators

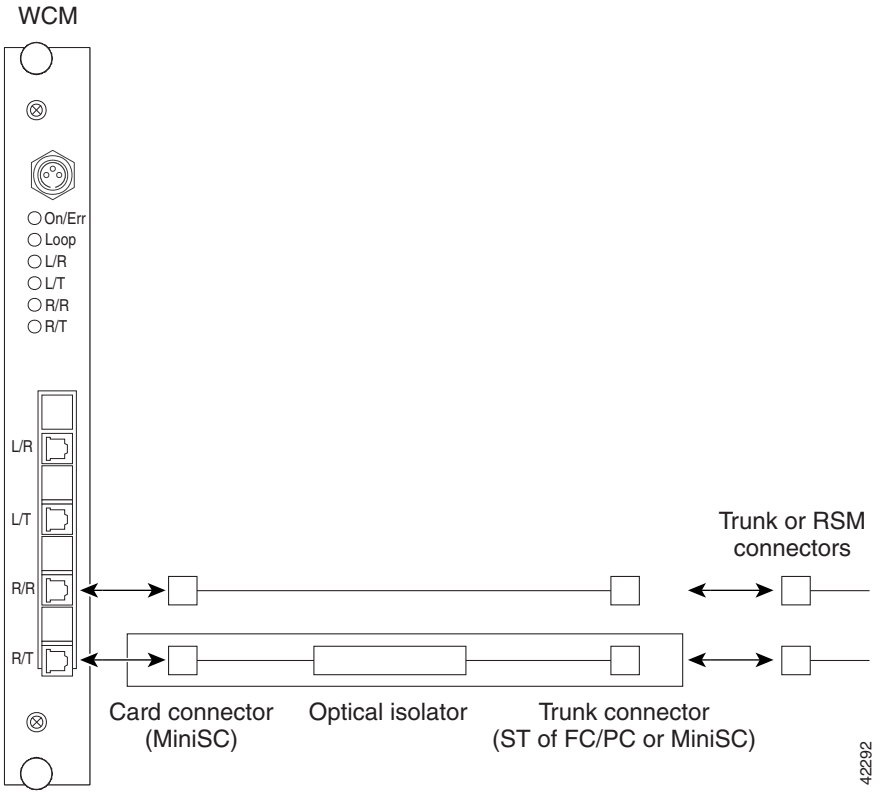
The Cisco Metro 1500 series optical isolator allows direct transmission from a WCM over a remote (or trunk) fiber. The optical isolator enables a WCM to bypass the multiplexer/demultiplexer (MUX/DMX) module in the system chassis. By connecting the WCM to the optical isolator through fiber jumpers, you can transmit directly over the remote fiber and obtain an additional 3 dB to 5 dB for use in your optical budget.

The optical isolator minimizes optical back reflection. Optical back reflection is common in fiber-based transmissions. Back reflection is a small amount of light that is reflected back towards the transmitting optical component. The optical isolator absorbs this reflected light so that the transmitting optical component operates with minimal interference.

Installation Notes

The optical isolator is connected directly to a jumper that extends from the remote connection of the WCM. The optical isolator sits between the WCM and the remote (or trunk) fiber. (See Figure 5-10.)

Figure 5-10 Optical Isolator Connection Scenario



To connect the optical isolator, follow these guidelines:

- The optical connector coming out of a WCM is MUPC type. Cisco stocks fiber jumpers that use an MU-to-SC type connection. This is the standard jumper configuration. However, the isolator can be used with a number of different connector types, if needed.
- The fiber jumper coming out of the WCM is connected to the fiber attached to the optical isolator. For example, two SC connectors are connected.
- The fiber on the other side of the optical isolator is connected to the trunk or remote fiber. For example, two SC connectors are connected.

Testing a Remote Link

The remote loopback feature of the WCM allows you to test the remote optical communications link without disconnecting the system. You must test the remote link to verify that it meets the specifications to ensure proper operation. Tests may already be available from the supplier of the fiber. If no report is available, perform the tests to verify that parameters are within specifications.

Table 5-1 lists the tests required for the remote link and the equipment required to perform each test.

Table 5-1 Tests and Equipment Required

Tests	Equipment Required
Optical link loss 1550 nm specified in dBm referenced to 1 mW	• Laser source at 1310 nm and 1550 nm • A power meter or OTDR[1]
Distance specified in km	OTDR
Optical return loss 1550 nm specified in dB	Reflectometer or OTDR with a reflectometer

1. OTDR = optical time domain reflectometer

To test a remote optical communications link, follow these steps:

Step 1 Disconnect the local lines from the WCMs at both the local and remote systems in the link to be tested.

Step 2 Supply a modulated light to the local receiver of the WCM.

This modulated light switches on the local receiver and the remote transmitter of the local system. The green L/R LED should be on. If the modulated light does not match the clock recovery frequency, assuming a clock recovery is installed and enabled, the Error Indicator LED will be red.

Step 3 Set the remote loopback of the corresponding WCM of the remote system.

The orange loop LED of the WCM in the remote system should be on. The remote receiver, the remote transmitter, and the local transmitter should operate and loopback the received signal to the local system. The R/R, R/T, and L/T LEDs

should be on. If the modulated light does not match the clock-recovery frequency, assuming a clock recovery is installed and enabled, the R/R LED will be red. The remote receiver of the local system sees the signal and transfers it to the local transmitter. The WCM in the local system should have the L/T, L/R, R/T, and R/R LEDs on.

Note If your test results deviate from these results and you cannot correct the problem, contact your Cisco service representative.

CHAPTER 6

Connecting Jumpers

This chapter provides information on jumper connections for wavelength channels with MUX/DMX, MUX/DMX with band splitter modules (BSMs), and BSM with remote switch modules (RSMs). It also provides an overview of the various jumper types used in these connections.

This chapter includes the following sections:

Connecting 16-Channel WCM System Jumpers

The jumper connections in this section are for a 16-channel system installed in a single rack with the following:

- Standard configuration of WCMs, MUX, BSM, RSM, Remote Line, BSM, DMX, and WCMs
- Jumper of single mode fiber with plugs MU-PC at both ends (MU/PC-MUPC-SM)
- Jumper length measured from ferrule-end to ferrule-end

Table 6-1 to Table 6-5 show the appropriate jumper lengths and the jumper connections in this section.

Table 6-1 Connecting Wavelength Channels CH1-CH8 with MUX/DMX 1-8

From			To			Jumper Length	
Chassis	Module	Connector	Chassis	Module	Connector	mm	(ft)
1	WCM	R/R	1	DMX 1-8	1	390	(1.27)
	CH 1	R/T		MUX 1-8	1	390	(1.27)
	WCM	R/R		DMX 1-8	2	390	(1.27)
	CH 2	R/T		MUX 1-8	2	390	(1.27)
	WCM	R/R		DMX 1-8	3	360	(1.18)
	CH 3	R/T		MUX 1-8	3	360	(1.18)
	WCM	R/R		DMX 1-8	4	360	(1.18)
	CH 4	R/T		MUX 1-8	4	360	(1.18)
	WCM	R/R		DMX 1-8	5	360	(1.18)
	CH 5	R/T		MUX 1-8	5	360	(1.18)
	WCM	R/R		DMX 1-8	6	360	(1.18)
	CH 6	R/T		MUX 1-8	6	360	(1.18)
	WCM	R/R		DMX 1-8	7	310	(1.01)
	CH 7	R/T		MUX 1-8	7	310	(1.01)
	WCM	R/R		DMX 1-8	8	310	(1.01)
	CH 8	R/T		MUX 1-8	8	310	(1.01)

Table 6-2 Connecting Wavelength Channels CH9-CH16 with MUX/DMX 9-16

From			To			Jumper Length	
Chassis	Module	Connector	Chassis	Module	Connector	mm	(ft)
2	WCM CH 9	R/R	2	DMX 9-16	9	390	(1.27)
		R/T		MUX 9-16	9	390	(1.27)
	WCM CH 10	R/R		DMX 9-16	10	390	(1.27)
		R/T		MUX 9-16	10	390	(1.27)
	WCM CH 11	R/R		DMX 9-16	11	360	(1.18)
		R/T		MUX 9-16	11	360	(1.18)
	WCM CH 12	R/R		DMX 9-16	12	360	(1.18)
		R/T		MUX 9-16	12	360	(1.18)
	WCM CH 13	R/R		DMX 9-16	13	360	(1.18)
		R/T		MUX 9-16	13	360	(1.18)
	WCM CH 14	R/R		DMX 9-16	14	360	(1.18)
		R/T		MUX 9-16	14	360	(1.18)
	WCM CH 15	R/R		DMX 9-16	15	310	(1.01)
		R/T		MUX 9-16	15	310	(1.01)
	WCM CH 16	R/R		DMX 9-16	16	310	(1.01)
		R/T		MUX 9-16	16	310	(1.01)

Table 6-3 Connecting MUX/DMX 1-16 (16) with BSM

From			To			Jumper Length	
Chassis	Module	Connector	Chassis	Module	Connector	mm	(ft)
1	DMX 1-8	D1	2	BSM	D1	750	(2.46)
	MUX 1-8	M1			M1	750	(2.46)
2	DMX 9-16	D2			D2	310	(1.01)
	MUX 9-16	M2			M2	310	(1.01)

Table 6-4 Connecting a BSM with a RSM

From			To			Jumper Length	
Chassis	Module	Connector	Chassis	Module	Connector	mm	(ft)
2	BSM	D	1	RSM	D	310	(1.01)
	BSM	M			M	310	(1.01)

Table 6-5 Jumper Overview

Quantity	Jumper Type	Jumper Length	
		mm	(ft)
12	MU/PC-MU/PC-SM	310	(1.01)
16	MU/PC-MU/PC-SM	360	(1.18)
8	MU/PC-MU/PC-SM	390	(1.27)
2	MU/PC-MU/PC-SM	750	(2.46)

Connecting 32-Channel WCM System Jumpers

The jumper connections in this section are for a 32-channel system installed in a single rack with the following:

- Standard configuration of WCMs, MUX, BSM, RSM, Remote Line, BSM, DMX, and WCMs
- Jumper of single mode fiber with plugs MU-PC at both ends (MU/PC-MUPC-SM)
- Jumper length measured from ferrule-end to ferrule-end

Table 6-6 to Table 6-12 show the appropriate jumper lengths and the jumper connections in this section.

Table 6-6 Connecting Wavelength Channels CH1-CH8 with MUX/DMX 1-8

From			To			Jumper Length	
Chassis	Module	Connector	Chassis	Module	Connector	mm	(ft)
1	WCM CH 1	R/R	1	DMX 1-8	1	390	(1.27)
		R/T		MUX 1-8	1	390	(1.27)
	WCM CH 2	R/R		DMX 1-8	2	390	(1.27)
		R/T		MUX 1-8	2	390	(1.27)
	WCM CH 3	R/R		DMX 1-8	3	360	(1.18)
		R/T		MUX 1-8	3	360	(1.18)
	WCM CH 4	R/R		DMX 1-8	4	360	(1.18)
		R/T		MUX 1-8	4	360	(1.18)
	WCM CH 5	R/R		DMX 1-8	5	360	(1.18)
		R/T		MUX 1-8	5	360	(1.18)
	WCM CH 6	R/R		DMX 1-8	6	360	(1.18)
		R/T		MUX 1-8	6	360	(1.18)
	WCM CH 7	R/R		DMX 1-8	7	310	(1.01)
		R/T		MUX 1-8	7	310	(1.01)
	WCM CH 8	R/R		DMX 1-8	8	310	(1.01)
		R/T		MUX 1-8	8	310	(1.01)

Table 6-7 Connecting Wavelength Channels CH9-CH16 with MUX/DMX 9-16

From			To			Jumper Length	
Chassis	Module	Connector	Chassis	Module	Connector	mm	(ft)
2	WCM	R/R	2	DMX 9-16	9	390	(1.27)
	CH 9	R/T		MUX 9-16	9	390	(1.27)
	WCM	R/R		DMX 9-16	10	390	(1.27)
	CH 10	R/T		MUX 9-16	10	390	(1.27)
	WCM	R/R		DMX 9-16	11	360	(1.18)
	CH 11	R/T		MUX 9-16	11	360	(1.18)
	WCM	R/R		DMX 9-16	12	360	(1.18)
	CH 12	R/T		MUX 9-16	12	360	(1.18)
	WCM	R/R		DMX 9-16	13	360	(1.18)
	CH 13	R/T		MUX 9-16	13	360	(1.18)
	WCM	R/R		DMX 9-16	14	360	(1.18)
	CH 14	R/T		MUX 9-16	14	360	(1.18)
	WCM	R/R		DMX 9-16	15	310	(1.01)
	CH 15	R/T		MUX 9-16	15	310	(1.01)
	WCM	R/R		DMX 9-16	16	310	(1.01)
	CH 16	R/T		MUX 9-16	16	310	(1.01)

Table 6-8 Connecting Wavelength Channels CH17-CH24 with MUX/DMX 17-24

From			To			Jumper Length	
Chassis	Module	Connector	Chassis	Module	Connector	mm	(ft)
3	WCM CH 17	R/R	3	DMX 17-24	17	390	(1.27)
		R/T		MUX 17-24	17	390	(1.27)
	WCM CH 18	R/R		DMX 17-24	18	390	(1.27)
		R/T		MUX 17-24	18	390	(1.27)
	WCM CH 19	R/R		DMX 17-24	19	360	(1.18)
		R/T		MUX 17-24	19	360	(1.18)
	WCM CH 20	R/R		DMX 17-24	20	360	(1.18)
		R/T		MUX 17-24	20	360	(1.18)
	WCM CH 21	R/R		DMX 17-24	21	360	(1.18)
		R/T		MUX 17-24	21	360	(1.18)
	WCM CH 22	R/R		DMX 17-24	22	360	(1.18)
		R/T		MUX 17-24	22	360	(1.18)
	WCM CH 23	R/R		DMX 17-24	23	310	(1.01)
		R/T		MUX 17-24	23	310	(1.01)
	WCM CH 24	R/R		DMX 17-24	24	310	(1.01)
		R/T		MUX 17-24	24	310	(1.01)

Table 6-9 Connecting Wavelength Channels CH25-CH32 with MUX/DMX 25-32

From			To			Jumper Length	
Chassis	Module	Connector	Chassis	Module	Connector	mm	(ft)
4	WCM CH 25	R/R	4	DMX 17-24	25	390	(1.27)
		R/T		MUX 17-24	25	390	(1.27)
	WCM CH 26	R/R		DMX 17-24	26	390	(1.27)
		R/T		MUX 17-24	26	390	(1.27)
	WCM CH 27	R/R		DMX 17-24	27	360	(1.18)
		R/T		MUX 17-24	27	360	(1.18)
	WCM CH 28	R/R		DMX 17-24	28	360	(1.18)
		R/T		MUX 17-24	28	360	(1.18)
	WCM CH 29	R/R		DMX 17-24	29	360	(1.18)
		R/T		MUX 17-24	29	360	(1.18)
	WCM CH 30	R/R		DMX 17-24	30	360	(1.18)
		R/T		MUX 17-24	30	360	(1.18)
	WCM CH 31	R/R		DMX 17-24	31	310	(1.01)
		R/T		MUX 17-24	31	310	(1.01)
	WCM CH 32	R/R		DMX 17-24	32	310	(1.01)
		R/T		MUX 17-24	32	310	(1.01)

Table 6-10 Connecting MUX/DMX 1-32 (32) with a BSM

From			To			Jumper Length	
Chassis	Module	Connector	Chassis	Module	Connector	mm	(ft)
1	DMX 1-8	D1	2	BSM	D1	750	(2.46)
	MUX 1-8	M1			M1	750	(2.46)
2	DMX 9-16	D2			D2	310	(1.01)
	MUX 9-16	M2			M2	310	(1.01)
3	DMX 17-24	D3			D3	750	(2.46)
	MUX 17-24	M3			M3	750	(2.46)
4	DMX 25-32	D4			D4	1300	(4.26)
	MUX 25-32	M4			M4	1300	(4.26)

Table 6-11 Connecting a BSM with an RSM

From			To			Jumper Length	
Chassis	Module	Connector	Chassis	Module	Connector	mm	(ft)
2	BSM	D	1	RSM	D	310	(1.01)
	BSM	M			M	310	(1.01)

Table 6-12 Jumper Overview

		Jumper Length	
Quality	Jumper Type	mm	(ft)
20	MU/PC-MU/PC-SM	310	(1.01)
32	MU/PC-MU/PC-SM	360	(1.18)
16	MU/PC-MU/PC-SM	390	(1.27)
4	MU/PC-MU/PC-SM	750	(2.46)
2	MU/PC-MU/PC-SM	1300	(4.26)

Connecting 32-Channel TDM4E System Jumpers

The jumper connections in this section are for a 128 ESCON channel system installed in two racks with the following:

- Standard configuration of TDM4Es, MUX, BSM, RSM, Remote Line, BSM, DMX, and TDM4Es
- Jumper of single mode fiber with plugs MU-PC at both ends (MU/PC-MUPC-SM)
- Jumper length measured from ferrule-end to ferrule-end

Table 6-13 to Table 6-23 shows the appropriate jumper lengths and the jumper connections in this section.

Table 6-13 Connecting Wavelength Channels CH1-CH4 with MUX/DMX 1-8

From				To				Jumper Length	
Rack	Chassis	Module	Connector	Rack	Chassis	Module	Connector	mm	(ft)
I	1	TDM4E CH 1	R/R	I	1	DMX 1-8	1	380	(1.24)
			R/T			MUX 1-8	1	300	(0.98)
		TDM4E CH 2	R/R			DMX 1-8	2	300	(0.98)
			R/T			MUX 1-8	2	280	(0.92)
		TDM4E CH 3	R/R			DMX 1-8	3	280	(0.92)
			R/T			MUX 1-8	3	260	(0.85)
		TDM4E CH 4	R/R			DMX 1-8	4	260	(0.85)
			R/T			MUX 1-8	4	260	(0.85)

Table 6-14 Connecting Wavelength Channels CH5-CH8 with MUX/DMX 1-8

From				To				Jumper Length	
Rack	Chassis	Module	Connector	Rack	Chassis	Module	Connector	mm	(ft)
I	2	TDM4E CH 5	R/R	I	1	DMX 1-8	5	800	(2.62)
			R/T			MUX 1-8	5	800	(2.62)
		TDM4E CH 6	R/R			DMX 1-8	6	820	(2.62)
			R/T			MUX 1-8	6	820	(2.62)
		TDM4E CH 7	R/R			DMX 1-8	7	840	(2.75)
			R/T			MUX 1-8	7	840	(2.75)
		TDM4E CH 8	R/R			DMX 1-8	8	860	(2.82)
			R/T			MUX 1-8	8	860	(2.82)

Table 6-15 Connecting Wavelength Channels CH9-CH12 with MUX/DMX 9-16

From				To				Jumper Length	
Rack	Chassis	Module	Connector	Rack	Chassis	Module	Connector	mm	(ft)
I	3	TDM4E CH 9	R/R	I	3	DMX 9-16	9	380	(1.24)
			R/T			MUX 9-16	9	300	(0.98)
		TDM4E CH 10	R/R			DMX 9-16	10	300	(0.98)
			R/T			MUX 9-16	10	280	(0.92)
		TDM4E CH 11	R/R			DMX 9-16	11	280	(0.92)
			R/T			MUX 9-16	11	260	(0.85)
		TDM4E CH 12	R/R			DMX 9-16	12	260	(0.85)
			R/T			MUX 9-16	12	260	(0.85)

Table 6-16 Connecting Wavelength Channels CH13-CH16 with MUX/DMX 9-16

From				To				Jumper Length	
Rack	Chassis	Module	Connector	Rack	Chassis	Module	Connector	mm	(ft)
I	4	TDM4E	R/R	I	3	DMX 9-16	13	800	(2.62)
		CH 13	R/T			MUX 9-16	13	800	(2.62)
		TDM4E	R/R			DMX 9-16	14	820	(2.69)
		CH 14	R/T			MUX 9-16	14	820	(2.69)
		TDM4E	R/R			DMX 9-16	15	840	(2.75)
		CH 15	R/T			MUX 9-16	15	840	(2.75)
		TDM4E	R/R			DMX 9-16	16	860	(2.82)
		CH 16	R/T			MUX 9-16	16	860	(2.82)

Table 6-17 Connecting Wavelength Channels CH17-CH20 with MUX/DMX 17-24

From				To				Jumper Length	
Rack	Chassis	Module	Connector	Rack	Chassis	Module	Connector	mm	(ft)
II	5	TDM4E	R/R	II	5	DMX 17-24	17	380	(1.24)
		CH 17	R/T			MUX 17-24	17	300	(0.98)
		TDM4E	R/R			DMX 17-24	18	300	(0.98)
		CH 18	R/T			MUX 17-24	18	280	(0.92)
		TDM4E	R/R			DMX 17-24	19	280	(0.92)
		CH 19	R/T			MUX 17-24	19	260	(0.85)
		TDM4E	R/R			DMX 17-24	20	260	(0.85)
		CH 20	R/T			MUX 17-24	20	260	(0.85)

Table 6-18 Connecting Wavelength Channels CH21-CH24 with MUX/DMX 17-24

From				To				Jumper Length	
Rack	Chassis	Module	Connector	Rack	Chassis	Module	Connector	mm	(ft)
II	6	TDM4E	R/R	II	5	DMX 17-24	21	800	(2.62)
		CH 21	R/T			MUX 17-24	21	800	(2.62)
		TDM4E	R/R			DMX 17-24	22	820	(2.69)
		CH 22	R/T			MUX 17-24	22	820	(2.69)
		TDM4E	R/R			DMX 17-24	23	840	(2.75)
		CH 23	R/T			MUX 17-24	23	840	(2.75)
		TDM4E	R/R			DMX 17-24	24	860	(2.82)
		CH 24	R/T			MUX 17-24	24	860	(2.82)

Table 6-19 Connecting Wavelength Channels CH25-CH28 with MUX/DMX 25-32

From				To				Jumper Length	
Rack	Chassis	Module	Connector	Rack	Chassis	Module	Connector	mm	(ft)
II	7	TDM4E	R/R	II	7	DMX 25-32	25	380	(1.24)
		CH 25	R/T			MUX 25-32	25	300	(0.98)
		TDM4E	R/R			DMX 25-32	26	300	(0.98)
		CH 26	R/T			MUX 25-32	26	280	(0.92)
		TDM4E	R/R			DMX 25-32	27	280	(0.92)
		CH 27	R/T			MUX 25-32	27	260	(0.85)
		TDM4E	R/R			DMX 25-32	28	260	(0.85)
		CH 28	R/T			MUX 25-32	28	260	(0.85)

Table 6-20 Connecting Wavelength Channels CH29-CH32 with MUX/DMX 25-32

From				To				Jumper Length	
Rack	Chassis	Module	Connector	Rack	Chassis	Module	Connector	mm	(ft)
II	8	TDM4E	R/R	II	7	DMX 25-32	29	800	(2.62)
		CH 29	R/T			MUX 25-32	29	800	(2.62)
		TDM4E	R/R			DMX 25-32	30	820	(2.69)
		CH 30	R/T			MUX 25-32	30	820	(2.69)
		TDM4E	R/R			DMX 25-32	31	840	(2.75)
		CH 31	R/T			MUX 25-32	31	840	(2.75)
		TDM4E	R/R			DMX 25-32	32	860	(2.82)
		CH 32	R/T			MUX 25-32	32	860	(2.82)

Table 6-21 Connecting MUX/DMX 1-32 (32) with a BSM

From				To				Jumper Length	
Rack	Chassis	Module	Connector	Rack	Chassis	Module	Connector	mm	(ft)
I	1	DMX 1-8	D1	I	2	BSM	D1	900	(2.95)
		MUX 1-8	M1				M1	900	(2.95)
	3	DMX 9-16	D2				D2	1000	(3.28)
		MUX 9-16	M2				M2	1000	(3.28)
II	5	DMX 17-24	D3				D3	4000	(13.12)
		MUX 17-24	M3				M3	4000	(13.12)
	7	DMX 25-32	D4				D4	4000	(13.12)
		MUX 25-32	M4				M4	4000	(13.12)

Table 6-22 Connecting a BSM with a RSM

From				To				Jumper Length	
Rack	Chassis	Module	Connector	Rack	Chassis	Module	Connector	mm	(ft)
I	2	BSM	D	I	1	RSM	D	1000	(3.28)
		BSM	M				M	1000	(3.28)

Table 6-23 Jumper Overview

		Jumper Length	
Quality	**Jumper Type**	mm	(ft)
12	MU/PC-MU/PC-SM	260	(0.85)
8	MU/PC-MU/PC-SM	280	(0.92)
8	MU/PC-MU/PC-SM	300	(0.98)
4	MU/PC-MU/PC-SM	380	(1.24)
8	MU/PC-MU/PC-SM	800	(2.62)
8	MU/PC-MU/PC-SM	820	(2.69)
8	MU/PC-MU/PC-SM	840	(2.75)
8	MU/PC-MU/PC-SM	860	(2.82))
2	MU/PC-MU/PC-SM	900	(2.95)
4	MU/PC-MU/PC-SM	1000	(3.28)
4	MU/PC-MU/PC-SM	4000	(13.12)

CHAPTER 7

Connecting NEMI and DEMI Modules

This chapter describes how to connect the NEMI and DEMI modules used in the Cisco Metro 1500 series system. This chapter includes the following sections:

Connection Equipment

Use the following connection equipment to connect the NEMI and DEMI modules:

- 9- to 16-channel system
  - One external bus cable to link the internal bus of the NEMI and DEMI modules
  - Two bus terminators— BUS 1 and BUS 2 ports on the NEMI module (the internal bus has to be terminated)
- 17- to 32-channel system
  - One external Ethernet 10BASE-T hub with a minimum of three ports
  - Two Ethernet cables to connect the NEMI-master and the NEMI-slaves to the Ethernet hub

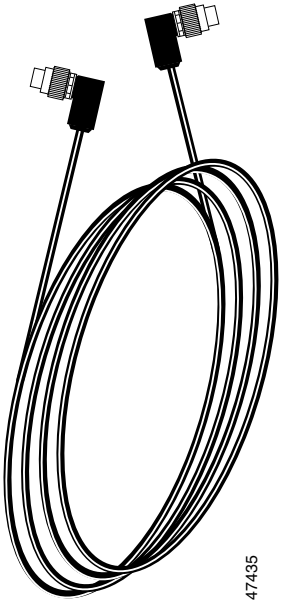
  - Two external bus cables to link the internal bus of the NEMI and DEMI modules
  - Four bus terminators—BUS 1 and BUS 2 ports on the NEMI modules (the internal bus has to be terminated)
- 128-channel ESCON system
  - One external Ethernet 10BASE-T hub with a minimum of five ports
  - Four Ethernet cables to connect the NEMI-master and the NEMI-slaves to the Ethernet hub
  - Four external bus cables to link the internal bus of the NEMI and DEMI modules
  - Eight bus terminators —BUS 1 and BUS 2 ports on the NEMI modules (the internal bus has to be terminated)

Connecting NEMI Modules to DEMI Modules

Use the external bus cable supplied to connect the NEMI in the primary chassis with the DEMI in extension chassis A. Figure 7-1 shows an external bus connector cable.

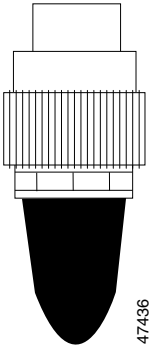
Note The external bus cable is included in the same box that contains the DEMI.

Figure 7-1 External Bus Connector Cable



The bus interconnect port two (BUS 2) on the DEMI connects it to the NEMI. BUS 1 port must be terminated with the bus terminator supplied to eliminate extraneous noise on the bus. Figure 7-2 shows the bus terminator.

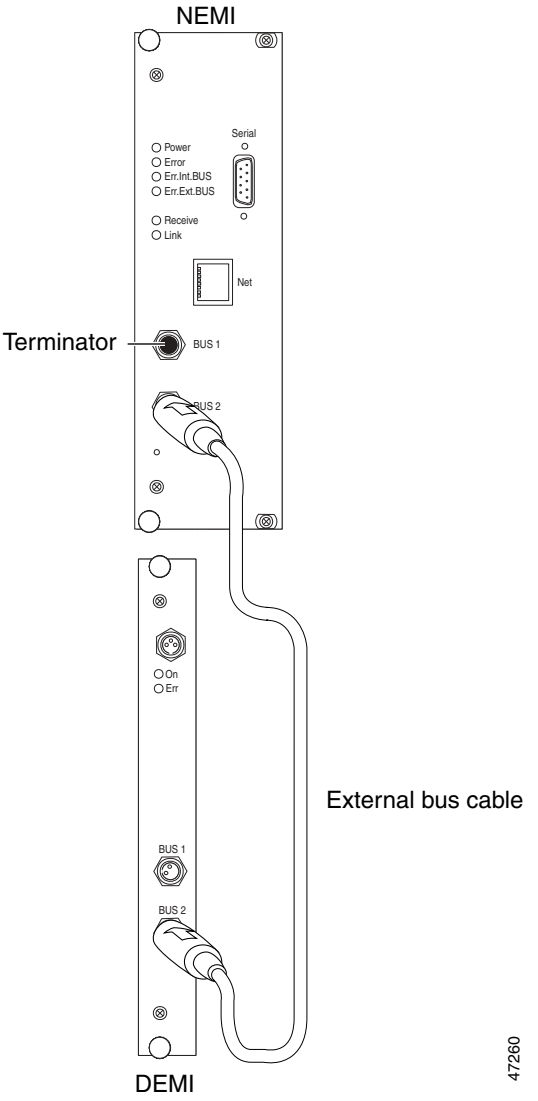
Figure 7-2 Bus Terminator



For a 17- to 32-channel system or for a 128-channel ESCON system, the NEMI-slaves in the extension chassis are connected to the DEMI modules in the extension chassis in the same manner as described in the "Connection Equipment" section on page 7-1.

Figure 7-3 shows how to connect the NEMI-master or the NEMI-slave with a DEMI.

Figure 7-3 Connecting a NEMI (Master or Slave) to a DEMI Module



Connecting NEMI Modules to an Ethernet Hub

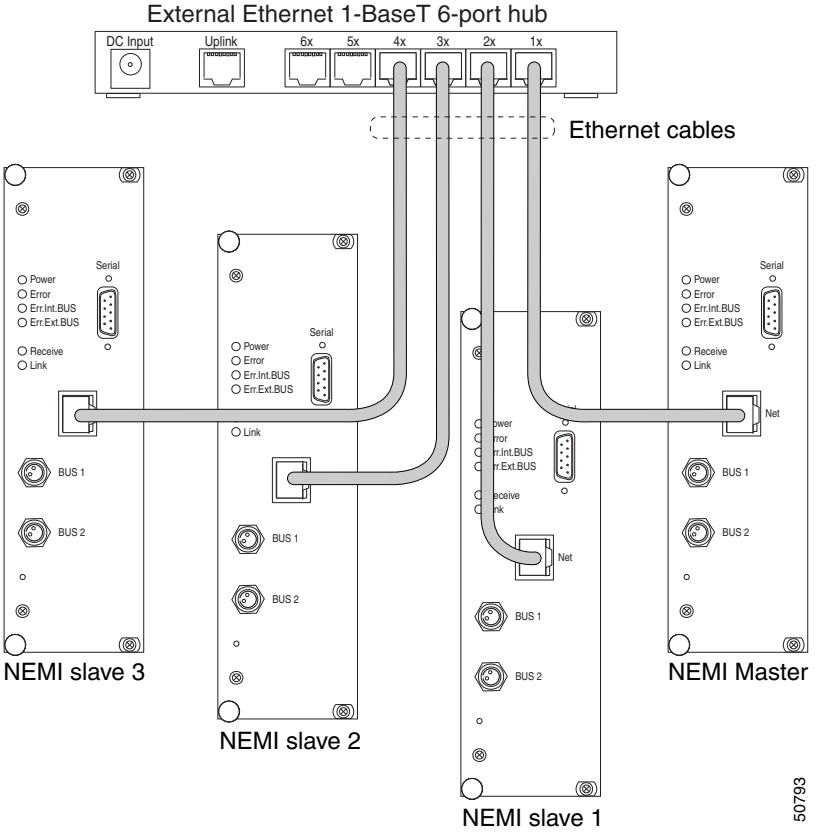
Cisco Metro 1500 series systems with a total of 17 to 32 WCMs require the NEMI-master to be installed in the primary chassis. The NEMI-master is then connected to the NEMI-slave installed in extension chassis B.

Systems with up to 128 ESCON channels require a NEMI-master to be installed in the primary chassis. The NEMI-master is then connected to the NEMI-slaves in extension chassis C, E, and G.

Both NEMI-master and NEMI-slaves must be connected to an external Ethernet hub with Ethernet cables. Figure 7-4 shows an example of these configurations.

Once interconnected, the NEMI modules exchange management and configuration control information across a private IP network. For information about configuring this private network, refer to the *Cisco Metro 1500 Series Software Configuration Guide*.

Figure 7-4 Connecting NEMI Modules with an External Ethernet Hub



To connect NEMI modules to an Ethernet hub, follow these steps:

Step 1 Use an Ethernet crossover cable (X-cable).

Step 2 Attach one end of an approved Ethernet cable to the RJ-45 Ethernet port of the NEMI-master in the primary chassis.

Step 3 Attach the other end of the cable to the RJ-45 Ethernet port of the external Ethernet hub. (See Figure 7-4.)

Step 4 Repeat these steps for all NEMI-slaves installed in chassis C, E, and G.

APPENDIX A

Specifications

This appendix provides the specifications for the Cisco Metro 1500 series system. This appendix includes the following sections:

Unit Configuration

The Cisco Metro 1500 series system is configured with one primary chassis and up to three extension chassis. (See Table A-1.)

Note Table A-1 lists the typical configuration for four chassis. The Cisco Metro 1500 Series can contain up to eight chassis.

Table A-1 System Component Configuration

Configuration Features	Primary Chassis	Extension Chassis		
		A	B	C
Standard				
Chassis	X	X	X	X
Up to 8 WCMs	X	X	X	X
Up to 4 TDM4Es	X	X	X	X
MUX for channels 1 to 8 of 32	X			
MUX for channels 9 to 16 of 32		X		
MUX for channels 17 to 24 of 32			X	
MUX for channels 25 to 32 of 32				X
DMX for channels 1 to 8 of 32	X			
DMX for channels 9 to 16 of 32		X		
DMX for channels 17 to 24 of 32			X	
DMX for channels 25 to 32 of 32				X
BSM		X		
DEMI		X		X
NEMI	X		X	
Optional				
RSM	X			

Chassis Specifications

The primary chassis and the extension chassis are built on the same chassis. Table A-2 lists the chassis specifications for the Cisco Metro 1500 series system.

Table A-2 Chassis Specifications

Description	Specification
Environmental	
Temperature, ambient operating[1]	41 to 113°F (5 to 45°C) (long-term conditions) 23 to 122°F (-5 to 50°C) (short-term conditions)
Temperature, ambient nonoperating and storage	14 to 158°F (-10 to 70°C)
Transportation temperature	14 to 158°F (-10 to 70°C)
Humidity (RH[2]), ambient (noncondensing) operating	10 to 90 percent RH noncondensing
Physical Characteristics	
Dimensions (HxWxD)	19 x 12 x 8 3/4 in (482 x 305 x 222 mm)
Weight	33 lb (15 kg) maximum per base unit
Optical ports	MiniSC (MU type)
Power	
AC-input voltage DC-input voltage	110 to 120 VAC 210 to 240 VAC
Typical voltage range	99 to 127.2 VAC 189 to 254.4 VAC -40 to -80 VDC
Current maximum	2.5A maximum or 4.0A maximum
Power consumption maximum	150 VAC maximum

Table A-2 Chassis Specifications (continued)

Description	Specification
Reliability	
MTBF[3] at 77°F (25°C)	442,488 hr
FITs[4] at 77°F (25°C)	2260
MTTR[5]	0.34 hr
Fuses, Fans and Power Supplies	
Fuses	2.5A, 250V, slow blowing, 5x20 mm (for AC version) or 6.3A, 250V, slow blowing, 5x20 mm (for DC version)
Fans	Two redundant fans
Power supplies	Two redundant power supplies

1. This is a room temperature range. The module temperature can be higher than the environmental measurement by 10 degrees or more.
2. RH = relative humidity.
3. MTBF = mean time between failures.
4. FITs = failures in time.
5. MTTR = mean time to repair.

Wavelength Channel Module Specifications

The Cisco Metro 1500 series system supports nine different wavelength channel module (WCM) configurations. These WCMs support only extended reach lasers. Table A-3 through Table A-10 list specifications for the following WCM configurations:

- Low-Speed Transparent WCM
- High-Speed Transparent WCM
- High-Speed WCM with 622-Mbps Clock
- High-Speed WCM with 1062-Mbps Clock for Coupling Link

- High-Speed WCM with 1062- or 1250-Mbps Clock
- High-Speed WCM with 2.488-Gbps Clock
- High-Speed WCM with 850-nm Multiclock
- TDM4E and WCM Specifications

Note All power measurements have to be done in-line because of automatic laser shutdown (ALS).

Low-Speed Transparent WCM

Table A-3 Low-Speed Transparent WCM Specifications

Description	Specification
Data Rate	
Range	10 to 200 Mbps
Local Link Ports [1]	
Transmitter wavelength	1260 to 1310 nm
Receiver wavelength	1260 to 1570 nm
Receiver dynamic range	-5.0 to -28.0 dBm
Transmitter output power	-16.0 to -21.0 dBm
Fiber type	Single mode or multimode
Link distance	Single mode: 0.62 mi (1 km) Multimode: 0.12 mi (0.2 km)
Connector type	MiniSC
Remote Link Ports [1]	
Wavelength	1 to 32 channels, ranging from 1531.90 to 1558.98 nm, according to ITU-T[2] G.692 200 GHz channel spacing
Receiver dynamic range	-5.0 to -28 dBm

Table A-3 Low-Speed Transparent WCM Specifications (continued)

Description	Specification
Transmitter Output Power (measured at WCM output)	
Extended	6.0 to 3.0 dBm
Link Loss Budget[3]	
Extended without RSM	7 to 22 dB
Extended with RSM	Up to 15 dB
Calculated Link Distance	
Extended without RSM	Up to 49.7 mi (80 km)
Extended with RSM	Up to 34.2 mi (55 km)
Calculated Link Distance	
Extended without RSM	Up to 49.7 mi (80 km)
Extended with RSM	Up to 34.2 mi (55 km)
System Performance	
Bit error ratio	10^{-12} for all applications 10^{-15} for ESCON[4]
Applications	
Supported applications	ATM, ESCON, Fast Ethernet, FDDI, Fibre Channel, OC-3, STM-1, plus proprietary protocols within the data range
Reliability	
MTBF[5] at 77°F (25°C)	1188655 hr
FITs[6] at 77°F (25°C)	841
MTTR[7]	0.12 hr

1. Local and remote optical loop only, specified for test and installation purposes only
2. ITU-T = International Telecommunication Union Telecommunication Standardization Sector
3. Optical budgets include the BSM and MUX/DMX
4. ESCON = Enterprise System Connection
5. MTBF = mean time between failures
6. FIT = failures in time
7. MTTR = mean time to repair

High-Speed Transparent WCM

Table A-4 High-Speed Transparent WCM Specifications

Description	Specification
Data Rate	
Range	100 to 1250 Mbps
Local Link Ports [1]	
Transmitter wavelength	1260 to 1360 nm
Receiver wavelength	1260 to 1570 nm
Receiver dynamic range	-7.0 to -21.0 dBm
Transmitter output power	Standard: -6.0 to -12.0 dBm 622 ATM multimode with clock: -16.0 to -19.0 dBm
Fiber type	Single mode or multimode
Link distance	Single mode: 0.62 mi (1 km) Multimode: 0.12 mi (0.2 km)
Connector type	MiniSC
Remote Link Ports [1]	
Wavelength	1 to 32 channels, ranging from 1531.90 to 1558.98 nm according to ITU-T[2] G.692 200 GHz
Receiver dynamic range	-7 to -30 dBm
Transmitter Output Power (measured at WCM output)	
Extended	6.0 to 3.0 dBm
Link Loss Budget[3]	
Extended without RSM	5 to 22 dB
Extended with RSM	Up to 15 dB
Calculated Link Distance	
Extended without RSM	Up to 49.7 mi (80 km)

Table A-4 High-Speed Transparent WCM Specifications (continued)

Description	Specification
Extended with RSM	Up to 34.2 mi (55 km)
System Performance	
Bit error ratio	10^{-12} for all applications 10^{-15} for ESCON[4]
Applications	
Supported applications	ATM, ESCON, Fast Ethernet, Fibre Channel, FDDI, Gigabit Ethernet, OC-3/-12, STM-1/4, coupling link[5], plus proprietary protocols within the data range
Reliability	
MTBF[6] at 77°F (25°C)	1188655 hr
FITs[7] at 77°F (25°C)	841

1. Local and remote optical loop only, specified for test and installation purposes only
2. ITU-T = International Telecommunication Union Telecommunication Standardization Sector
3. Optical budgets include the BSM and MUX/DMX
4. ESCON = Enterprise System Connection
5. Maximum link distance is 25 km; local receiver dynamic range is -3 dBm to -17 dBm
6. MTBF = mean time between failures
7. FITs = failures in time

High-Speed WCM with 622-Mbps Clock

Table A-5 High-Speed WCM with 622-Mbps Clock Specifications

Description	Specification
Clock data rates	622 Mbps
Local Link Ports [1]	
Transmitter wavelength	1260 to 1310 nm
Receiver wavelength	1260 to 1570 nm

Table A-5 High-Speed WCM with 622-Mbps Clock Specifications (continued)

Description	Specification
Receiver dynamic range	-7.0 to -21.0 dBm
Transmitter output power	-16.0 to -21.0 dBm
Fiber type	Single mode or multimode
Link distance	Single mode: 0.62 mi (1 km) Multimode: 0.12 mi (0.2 km)
Connector type	MiniSC
Remote Link Ports [1]	
Wavelength	1 to 32 channels, ranging from 1531.90 to 1600.60 nm according to ITU-T[2] G.692
Transmitter Output Power (measured at WCM output)	
Extended	6.0 to 3.0 dBm
Link Loss Budget[3]	
Extended without RSM	5 to 22 dB
Extended with RSM	Up to 15 dB
Calculated Link Distance	
Extended without RSM	Up to 49.7 mi (80 km)
Extended with RSM	Up to 34.2 mi (55 km)
System Performance	
Bit error ratio	10^{-12} for all applications 10^{-15} for ESCON[4]
Applications	
Supported applications	ATM, OC-12, STM-4, plus proprietary protocols within the data range

Table A-5 High-Speed WCM with 622-Mbps Clock Specifications (continued)

Description	Specification
Reliability	
MTBF[5] at 77°F (25°C)	1188655 hr
FITs[6] at 77°F (25°C)	841
MTTR[7]	0.12 hr

1. Local and remote optical loop only, specified for test and installation purposes only
2. ITU-T = International Telecommunication Union Telecommunication Standardization Sector
3. Optical budgets include the BSM and MUX/DMX
4. ESCON = Enterprise System Connection
5. MTBF = mean time between failures
6. FITs = failures in time
7. MTTR = mean time to repair

High-Speed WCM with 1062-Mbps Clock for Coupling Link

Table A-6 High-Speed WCM with 1062-Mbps Clock for Coupling Link Specifications

Description	Specification
Data Rate	
Clock data rate	1062 Mbps
Local Link Ports [1]	
Transmitter wavelength	1260 to 1360 nm
Receiver wavelength	1260 to 1570 nm
Receiver dynamic range	-3 to -17.0 dBm
Transmitter output power	-6.0 to -12.0 dBm
Fiber type	Single mode or multimode
Link distance	Single mode: 0.62 mi (1 km) Multimode: 0.12 mi (0.2 km)
Connector type	MiniSC

Table A-6 High-Speed WCM with 1062-Mbps Clock for Coupling Link Specifications (continued)

Description	Specification
Remote Link Ports [1]	
Wavelength	1 to 32 channels, ranging from 1531.90 to 1600.60 nm according to ITU-T[2] G.692
Transmitter Output Power (measured at WCM output)	
Extended	6.0 to 3.0 dBm
Link Loss Budget[3]	
Extended without RSM	5 to 22 dB
Extended with RSM	Up to 15 dB
Calculated Link Distance	
Extended without RSM	15.54 mi (25 km)
Extended with RSM	15.54 mi (25 km)
System Performance	
Bit error ratio	10^{-12} for all applications
Applications	
Supported applications	Coupling link
Reliability	
MTBF[4] at 77°F (25°C)	1188655 hr
FITs[5] at 77°F (25°C)	841
MTTR[6]	0.12 hr

1. Local and remote optical loop only, specified for test and installation purposes only
2. ITU-T = International Telecommunication Union Telecommunication Standardization Sector
3. Optical budgets include the BSM and MUX/DMX
4. MTBF = mean time between failures
5. FITs = failures in time
6. MTTR = mean time to repair

High-Speed WCM with 1062- or 1250-Mbps Clock

Table A-7 High-Speed WCM with 1062- or 1250-Mbps Clock Specifications

Description	Specification
Data Rate	
Clock data rates	1062 Mbps, 1250 Mbps
Local Link Ports [1]	
Transmitter wavelength	1260 to 1310 nm
Receiver wavelength	1260 to 1570 nm
Receiver dynamic range	-7.0 to -21.0 dBm
Transmitter output power	-6.0 to -12.0 dBm
Fiber type	Single mode or multimode
Link distance	Single mode: 0.62 mi (1 km) Multimode: 0.12 mi (0.2 km)
Connector type	MiniSC
Remote Link Ports [1]	
Wavelength	1 to 32 channels, ranging from 1531.90 to 1600.60 nm according to ITU-T[2] G.692
Transmitter Output Power (measured at WCM output)	
Extended	6.0 to 3.0 dBm
Link Loss Budget[3]	
Extended without RSM	5 to 22 dB
Extended with RSM	Up to 15 dB
Calculated Link Distance	
Extended without RSM	Up to 49.7 mi (80 km)
Extended with RSM	Up to 34.2 mi (55 km)
System Performance	
Bit error ratio	10^{-12} for all applications

Table A-7 High-Speed WCM with 1062- or 1250-Mbps Clock Specifications (continued)

Description	Specification
Applications	
Supported applications	Fibre Channel, OC-12, STM-4, and proprietary protocols at the data rates
Reliability	
MTBF[4] at 77°F (25°C)	1188655 hr
FITs[5] at 77°F (25°C)	841
MTTR[6]	0.12 hr

1. Local and remote optical loop only, specified for test and installation purposes only
2. ITU-T = International Telecommunication Union Telecommunication Standardization Sector
3. Optical budgets include the BSM and MUX/DMX
4. MTBF = mean time between failures
5. FITs = failures in time
6. MTTR = mean time to repair

High-Speed WCM with 2.488-Gbps Clock

Table A-8 High-Speed WCM with 2.488-Gbps Clock Specifications

Description	Specification
Data Rate	
Clock data rate	2.488 Gbps
Local Link Ports [1]	
Transmitter wavelength	1260 to 1360 nm
Receiver wavelength	1260 to 1570 nm
Receiver dynamic range	-3.0 to -18.0 dBm
Transmitter output power	-3.0 to -10.0 dBm
Fiber type	Single mode
Link distance	Single mode: 1.24 mi (2 km)

Table A-8 High-Speed WCM with 2.488-Gbps Clock Specifications (continued)

Description	Specification
Connector type	MiniSC
Remote Link Ports [1]	
Wavelength	1 to 32 channels, ranging from 1531.90 to 1600.60 nm according to ITU-T[2] G.692
Transmitter Output Power (measured at WCM output)	
Extended	7.0 to 4.0 dBm
Link Loss Budget[3]	
Extended without RSM	8 to 17 dB
Extended with RSM	Up to 10 dB
Calculated Link Distance	
Extended without RSM	Up to 37.28 mi (60 km)
Extended with RSM	Up to 24.86 mi (40 km)
System Performance	
Bit error ratio	10^{-12} for all applications
Applications	
Supported applications	OC-48, STM-16, plus proprietary protocols within the data range
Reliability	
MTBF[4] at 77°F (25°C)	1188655 hr
FITs[5] at 77°F (25°C)	841
MTTR[6]	0.12 hr

1. Local and remote optical loop only, specified for test and installation purposes only
2. ITU-T = International Telecommunication Union Telecommunication Standardization Sector
3. Optical budgets include the BSM and MUX/DMX
4. MTBF = mean time between failures
5. FITs = failures in time
6. MTTR = mean time to repair

High-Speed WCM with 850-nm Multiclock

Table A-9 High-Speed WCM with 850-nm Multiclock Specifications

Description	Specification
Data Rate	
Clock data rates	1062.5 Mbps, 1250 Mbps
Local Link Ports	
Transmitter wavelength	830 to 860 nm
Receiver wavelength	770 to 860 nm
Receiver dynamic range	-3.0 to -17.0 dBm
Transmitter output power	0.0 to -9.0 dBm
Fiber type	Multimode
Link distance	Multimode: 0.12 mi (0.2 km)
Connector type	MiniSC
Remote Link Ports of WDM Channel Module	
Wavelength	ITU-T[1] G.692; 200-GHz channel spacing
Transmitter output power (measured at WCM output)	6.0 dBm to 3.0 dBm
Remote Link Budget for 32-Channel System	
Link loss budget for 32-channel system with BSM but without RSM	7 to 22 dB
Link loss budget for 32-channel system with BSM and with RSM	1 to 15 dB
Calculated link distance (with 1550-nm range) with BSM but without RSM	Up to 43.49 mi (70 km)
Calculated link distance (with 1550-nm range) with BSM and with RSM	Up to 31.07 mi (50 km)
Connector type	MiniSC

Table A-9 High-Speed WCM with 850-nm Multiclock Specifications (continued)

Description	Specification
System Performance	
Bit error rate	$\leq 10^{-12}$
Applications	
Supported applications	Gigabit Ethernet, Fibre Channel

1. ITU-T=International Telecommunications Union Telecommunication Standardization Sector

TDM4E and WCM Specifications

Table A-10 TDM4E and WCM Specifications

Description	Specification
Environmental	
Temperature	41 to 113°F (5 to 45°C)
Humidity (RH[1]), ambient (noncondensing) operating	10 to 90 percent
Physical Characteristics	
Dimensions (H x W x D)	233 mm x 8TE[2] x 160 mm
Connector type	MiniSC
Power	
Voltage	5V
Power consumption	150W
Local Link Ports	
Clock data rate	4 x 200 Mbps (4 ESCON[3] channels)
Transmitter wavelength range	1260 to 1360 nm
Receiver wavelength range	1280 to 1570 nm
Receiver dynamic range	-5.0 to -28.0 dBm

Table A-10 TDM4E and WCM Specifications (continued)

Description	Specification
Transmitter output power range standard	-16.0 to -21.0 dBm
Fiber type	Multimode
Link distance	0.62.5 mi (1 km)
Remote Link Ports	
Clock data rate	1250 Mbps
Wavelength	ITU-T[4] G.692; 200-GHz spacing
Remote Fiber	
Fiber type	Single mode
Cladding diameter	125 ± 1.0 micron
Cutoff wavelength	<1260 nm
Receiver dynamic range	-7.0 to -30.0 dBm
Transmitter output power range standard	6.0 to 3.0 dBm
Remote Link Budget for 32 Channel System	
Link loss rate with BSM but without switch	7 to 22 dB
Link loss rate with BSM and with switch	1 to 15 dB
Calculated link distance without switch	Up to 43.49 mi (70 km)
Calculated link distance with switch	Up to 31.07 mi (50 km)
Insertion loss for BSM module as a pair	4.3 dB
Remote Link Budget for 8-Channel System Without BSM[5]	
Link loss range without switch	11 to 26 dB
Link loss range with switch	5 to 19 dB

Table A-10 TDM4E and WCM Specifications (continued)

Description	Specification
Calculated link distance without switch	Up to 52.81 mi (85 km)
Calculated link distance with switch	Up to 37.28 mi (60 km)
Remote Link Budget with Converter Kit (patch cord with 1-dB fiber-optic isolator[6])	
Link loss range without switch	12 to 30 dB
Calculated link distance without switch	Up to 62.14 mi (100 km)
Clock Options	
Fixed clock	200 Mbps
System Performance	
Bit error rate	$\leq 10^{-15}$ for ESCON
Network Element Management Interface	
SNMP interface	RS-232: connector SUB-D9 10BASE-T: connector RJ-45
Applications	
Electrical multiplexing from one to four optical ESCON channels to one optical high-speed channel (Gigabit Ethernet) and electrical demultiplexing	
Data direction	Bidirectional, two fibers
Supported applications	ESCON
System Configuration	
Maximum (managed, protected)	32 x TDM channel module 4 x ESCON
	4 x multiplexer module
	1 x remote switch module
	1 x band splitter module
	4 x NEMI
	4 x DEMI
	8 x Frame AC or DC version

Table A-10 TDM4E and WCM Specifications (continued)

Description	Specification
Minimum (unmanaged, unprotected)	1 x TDM channel module 4 x ESCON
	1 x converter card option
	1 x frame AC or DC version
	Mixed configurations of TDM channel modules and WDM channel modules within one frame or between frames are allowed in Release 2.0

1. RH = relative humidity
2. TE = terminal equipment
3. ESCON = Enterprise System Connection
4. ITU-T = International Telecommunications Union Telecommunication Standardization Sector
5. Eight channel system without BSM: upgrade is not possible in-service
6. Converter kit cannot be used with MUX/DMX and BSM

Optical Isolator Specifications

Table A-11 lists the specifications of the optical isolator.

Table A-11 Optical Isolator Specifications

Description	Specification
Wavelength band	1520 to 1620 nm
Typical peak isolation	53 dB minimum
Minimum isolation	32 dB minimum
Typical insertion loss	0.7 dB
Maximum insertion loss	1.2 dB maximum
Return loss	58 dB minimum
PDL[1]	0.15 dB maximum
PMD[2]	0.07 ps[3] maximum

Table A-11 Optical Isolator Specifications

Description	Specification
Maximum optical power	300 mW
Maximum tensile load	5 N[4]
Operating temperature	-20 to + 60°C
Storage temperature	-40 to + 85°C
Fiber length	1 m

1. PDL = polarization dependent loss, which is measured in decibels (dB).
2. PMD = polarization mode dispersion, which is measured in time over distance.
3. ps = picoseconds, where ps = 10^{-12} seconds.
4. N = newton; in the meter-kilogram-second system, the unit of force required to accelerate a mass of one kilogram one meter per second, equal to 100,000 dynes. (A dyne is the unit of force in the centimeter-gram-second system equal to the force that would give a free mass of one gram an acceleration of one centimeter per second.)

Multiplexer and Demultiplexer Module Specifications

Four MUX and DMX pairs are supported, one set for the primary chassis and one set each for extension chassis A, B, and C.

Primary Chassis MUX and DMX (1 to 8 of 32)

The primary chassis MUX and DMX pair described in Table A-12 supports up to eight WCMs with their associated wavelengths.

Table A-12 Primary Chassis MUX and DMX Specifications

Description	Specification
Insertion loss	10 dB maximum
Channel insulation	30 dB minimum
WCM Channel Number	**Wavelength (nm)**
1	1558.98
2	1557.36
3	1555.75
4	1554.13
5	1552.52
6	1550.92
7	1549.32
8	1547.72

Extension Chassis A MUX and DMX (9 to 16 of 32)

The extension chassis A MUX and DMX pair described in Table A-13 supports up to eight WCMs with their associated wavelengths.

Table A-13 Extension Chassis A MUX and DMX Specifications

Description	Specification
Insertion loss	10 dB maximum
Channel insulation	30 dB minimum
WCM Channel Number	**Wavelength (nm)**
9	1542.94
10	1541.35
11	1539.77
12	1538.19
13	1536.61
14	1535.04
15	1533.47
16	1531.90

Extension Chassis B MUX and DMX (17 to 24 of 32)

The extension chassis B MUX and DMX pair described in Table A-14 supports up to eight WCMs with their associated wavelengths.

Table A-14 Extension Chassis B MUX and DMX Specifications

Description	Specification
Insertion loss	10 dB maximum
Channel insulation	30 dB minimum
WCM Channel Number	**Wavelength (nm)**
17	1572.06
18	1573.71

Table A-14 Extension Chassis B MUX and DMX Specifications (continued)

Description	Specification
19	1575.37
20	1577.03
21	1578.69
22	1580.35
23	1582.02
24	1583.69

Extension Chassis C MUX and DMX (25 to 32 of 32)

The extension chassis C MUX and DMX pair described in Table A-15 supports up to eight WCMs with their associated wavelengths.

Table A-15 Extension Chassis C MUX and DMX Specifications

Description	Specification
Insertion loss	10 dB maximum
Channel insulation	30 dB minimum
WCM Channel Number	**Wavelength (nm)**
25	1588.73
26	1590.41
27	1592.10
28	1593.79
29	1595.49
30	1597.19
31	1598.89
32	1600.60

Band Splitter Module

Table A-16 describes BSM support for four groups with the following wavelength ranges.

Table A-16 BSM Specifications

Description	Specification
Group	**Wavelength Range (nm)**
Insertion loss	2 dB maximum
Channel insulation	30 dB maximum
1 to 8	1547 to 1559
9 to 16	1531 to 1544
17 to 24	1571 to 1585
25 to 32	1588 to 1601

Remote Switch Module Specifications

Table A-17 lists the RSM specifications.

Table A-17 RSM Specifications

Description	Specification
Fiber route diversity	1:1 Protection
Switch over time	<50 ms
Insertion loss	2 dB maximum
Insulation	30 dB minimum

Network Element Management Interface Specifications

Table A-18 describes the hardware, interface, and software specifications for the NEMI.

Table A-18 NEMI Specifications

Description	Specification
Hardware	
RAM	16 MB
Flash	24 MB
Processor	AMD 486, 133 MHz
WatchDog	Yes
BIOS	Year 2000 compliant
Interfaces	
EIA/TIA-232	38.4 Kbps with a direct connection over LapLink cable, PPP connection over a leased line, or dial in using a modem
Network interface	Personal Computer Interconnect (PCI) 10 Mbps
BUS 1	Proprietary
BUS 2	Proprietary
Software	
OS	LINUX 2.0.35
Protocols	PPP, FTP, Telnet, SNMP
Applications	Netconfig, SNMP config, ocmstate

SNMP Features

SNMP provides an upgrade path for application software. The reprogramming of the Flash disk over Ethernet or serial port service depends on a maintenance contract. Table A-19 shows the SNMP configuration data.

Note All data marked Automatic read is automatically supplied to the NEMI.

Table A-19 SNMP Configuration Data

Feature	SNMP Management
WCM	
Serial no.	Automatic read
Channel location	Automatic read
Clock (yes/no)	Automatic read
Cooled laser (yes/no)	Automatic read
Chassis	
Power supply available (yes/no)	Automatic read
Fan available (yes/no)	Automatic read

Table A-20 shows the SNMP monitoring of technical operating conditions.

Table A-20 SNMP Monitoring of Technical Operating Conditions

Feature	SNMP Management
Generally	
Power supply failure (yes/no)	Automatic read
Fan failure (yes/no)	Automatic read
Environmental temperature (of converter card)	Automatic read
Laser temperature (stabilized laser only)	Automatic read

Table A-20 SNMP Monitoring of Technical Operating Conditions (continued)

Feature	SNMP Management
Laser current (stabilized laser only)	Automatic read
Local Receiver	
Loss of signal	Read
Remote Receiver	
Loss of signal	Read
Local Transmitter	
Status of laser (on/off)	Read
Remote Transmitter	
Status of laser (on/off)	Read
Multiclock	
Enable (on/off)	Read/write [1]
Read clock setting (125, 155 or 200, 266 Mbps)	Read
Set clock to 125, 155, 200, 266 Mbps	Write [1]
Clock Synchronized (yes/no)	Read specification

1. We do not recommend this option because SNMP does not require a password. Use Telnet when a password requirement exists.

Device Element Management Interface Specifications

Table A-21 shows the specifications for the DEMI.

Note All data access is performed through the NEMI.

Table A-21 DEMI Specifications

Description	Specification
Interfaces	
BUS 1	Proprietary
BUS 2	Proprietary

APPENDIX B

Cables and Cabling

This appendix lists the pin-to-pin connections for cables used by the Cisco Metro 1500 series system. This appendix includes the following sections:

Serial Null Modem Cable

Table B-1 shows the null modem cable wiring. It shows the signaling between machines that allows you to use hardware RTS/CTS flow control.

Table B-1 Wiring for Serial Null Modem Cable

Pin Signal	Pin ---------- Pin
CD	1 ---------- 4
Rx Data	2 ---------- 3
Tx Data	3 ---------- 2
DTR	4 ---------- 1
Ground	5 ---------- 5
DSR	6
RTS	7 ---------- 8

Table B-1 Wiring for Serial Null Modem Cable (continued)

Pin Signal	Pin ---------- Pin
CTS	8 ---------- 7
RI	9 ---------- 9

UTP-X Cables

The cables described in this section interconnect systems either directly or through a network hub.

Male Cable Connector

To find pin 1 on a 10BASE-T plug, follow these steps:

Step 1 Hold the cable in your right hand with the connector up and the cable dangling down.

Step 2 Turn the connector around so that the flat side is toward you and the plastic tag is away from you.

Step 3 Pin 1 is to the left, as shown in Figure B-1.

Figure B-1 Male 10BASE-T Plug

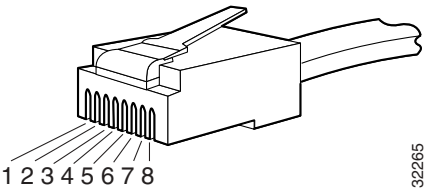


Table B-2 lists cable specifications for 10BASE-T connectors.

Pin Connections

There is no specified color coding for cables under 10BASE-T. Color coding for wiring under the EIA/TIA-568B standard is given for use with striped twisted pair. Whether you are using striped twisted pair or solid color twisted pair, follow the appropriate wiring diagrams in Table B-2 and Table B-3.

Note It is important that wiring be done using twisted pairs. Pins 1 and 2 should be wired using one twisted pair and pins 3 and 6 should be wired using a second twisted pair.

Straight-through cables are used in a star-based setup to connect systems to a hub. Table B-2 contains the cabling diagram for a straight-through cable.

Table B-2 Wiring for 10BASE-T Straight-Through Cable

Pinout	Striped Color	Solid Color
Pin 1 (TD+) ---------- (TD+) Pin 1	White/Orange	Green
Pin 2 (TD-) ---------- (TD-) Pin 2	Orange	Yellow
Pin 3 (RD+) ---------- (RD+) Pin 3	White/Green	Blue
Pin 4 --------(Not used by 10BASE-T)------- Pin 4	Blue	Red
Pin 5 --------(Not used by 10BASE-T)------- Pin 5	White/Blue	Black
Pin 6 (RD-) ---------- (RD-) Pin 6	Green	Orange
Pin 7 --------(Not used by 10BASE-T)------- Pin 7	White/Brown	Brown
Pin 8 --------(Not used by 10BASE-T)------- Pin 8	Brown	Grey

Crossover or X cables connect two systems directly together without using a hub. Crossover cables also connect stacked 10BASE-T hubs. Table B-3 contains the cabling diagram for a crossover cable.

Table B-3 Wiring for 10BASE-T Crossover Cable

Pinout	Striped Color	Solid Color
Pin 1 (TD+) ---------- (RD+) Pin 3	White/Orange	Green
Pin 2 (TD-) ---------- (RD-) Pin 6	Orange	Yellow
Pin 3 (RD+) ---------- (TD+) Pin 1	White/Green	Blue
Pin 4 --------(Not used by 10BASE-T)------- Pin 4	Blue	Red
Pin 5 --------(Not used by 10BASE-T)------- Pin 5	White/Blue	Black
Pin 6 (RD-) ---------- (TD-) Pin 2	Green	Orange
Pin 7 --------(Not used by 10BASE-T)------- Pin 7	White/Brown	Brown
Pin 8 --------(Not used by 10BASE-T)------- Pin 8	Brown	Grey

Table B-4 contains the cable specification for the twisted pair wire used in wiring the cables.

Table B-4 Cable Specification

Power	Cable Type	Category
100 ohm[1]	4-pair unshielded/shielded twisted-pair (UTP/STP)[2]	3 to 5
150 ohm[3]	2-pair shielded twisted-pair (STP)	3 to 5

1. Maximum segment distance = 100 meters
2. UTP/STP = unshielded twisted pair/shielded twisted pair
3. Maximum segment distance = 100 meters

APPENDIX C

NEMI Software Specifications

This appendix lists the hardware and software specifications of the NEMI, settings for an external modem, and the SNMP protocols for the wavelength channel modules (WCMs). This appendix includes the following sections:

NEMI Software

The NEMI software consists of the following:

- Linux 2.0.35
- SNMP agent
- Telnet server
- FTP server
- NTP server

Note NEMI software can be upgraded through Ethernet or serial ports. Flash memory can be reprogrammed through an Ethernet or serial port connection. Refer to the *Cisco Metro 1500 Series Software Configuration Guide* for more NEMI information.

The modem should be connected by a cable that can transmit all the signals listed in Table C-1 to the NEMI DB9 serial connector.

Table C-1 DB9 Serial Connector Signal

Signal	Description	Pin
RxD	Receive data	2
TxD	Transmit data	3
DTR	Data terminal ready	4
GND	Signal ground	5
DSR	Data set ready	6
RTS	Request To Send	7
CTS	Clear To Send	8
RI	Ring indicator	9

SNMP Features of WCMs

When a WCM is installed, the data marked “Automatic Read” is automatically supplied to the NEMI. See Table C-2 through Table C-7.

Table C-2 Configuration Data

Feature	SNMP Management
Serial no.	Automatic Read
Channel location	Automatic Read
Clock (yes/no)	Automatic Read
Cooled laser (yes/no)	Automatic Read
Power supply available (yes/no)	Automatic Read
Fan available (yes/no)	Automatic Read

Table C-3 Monitoring of Technical Operation Conditions

Feature	SNMP Management
Power supply failure (yes/no)	Automatic Read
Fan failure (yes/no)	Automatic Read
Environmental temperature (of converter card)	Automatic Read
Laser temperature (stabilized laser only)	Automatic Read
Laser current (stabilized laser only)	Automatic Read

Table C-4 WCM Receivers and Transmitters

Receiver or Transmitter	Feature	SNMP Management
Local receiver	Loss of signal	Read
Remote receiver	Loss of signal	Read
Local transmitter	Status of laser (on/off)	Read
Remote transmitter	Status of laser (on/off)	Read

Table C-5 Low-Speed Multiclock

Feature	SNMP Management
Enable (on/off)	Read/Write[1]
Read clock setting (125, 155, or 200, 266) Mbps	Read
Set clock to (125, 155, 200, 266) Mbps	Write[1]
Clock Synchronized (yes/no)	Read

1. This option is not writable by SNMP, but by management programs.

Table C-6 High-Speed Multiclock

Feature	SNMP Management
Enable (on/off)	Read/Write[1]
Read clock setting (155, 622, 1244, 1062, 1250) Mbps	Read
Set clock to (155, 622, 1244, 1062, 1250) Mbps	Write[1]
Clock synchronized (yes/no)	Read

1. This option is not writable by SNMP, but by management programs.

Table C-7 Fixed Clock Option

Feature	SNMP Management
Enable (on/off)	Not supported
Read clock setting	Read
Set clock	Not supported
Clock synchronized	Read

APPENDIX D

Acronyms

This appendix contains the acronyms used in this book. Table D-1 lists the terms and their spelled out forms.

Table D-1 Acronyms Used in This Guide

Acronyms	Expansions
A/R	line A receiver input (on RSM)
A/T	line A transmitter input (on RSM)
AC	alternating current
ALS	automatic laser shutdown
ASN.1	Abstract Syntax Notation One
ATM	Asynchronous Transfer Mode
B/R	line B receiver input (on RSM)
B/T	line B transmitter input (on RSM)
BSM	band splitter module
°C	degree Celsius
CCO	converter card option
CH	channel
CL	coupling link
CPU	central processing unit
CRT	terminal emulation protocol (like Telnet)

Table D-1 Acronyms Used in This Guide (continued)

Acronyms	Expansions
CTS	Clear To Send
D	common receiver output (on RSM)
dB	decibel
dBm	decibels per milliwatt
DC	direct current
DEMI	device element management interface
DIN	Deutsche Industrie Norm
DMX	demultiplexer module
DNSA	domain name server address
DWDM	dense wavelength division multiplexing
e/o	electrical to optical conversion
EMC	electromagnetic compatibility
EMI	electromagnetic interference
EPLD	electronically programmable logic device
Err	error
ESCON	Enterprise System Connection
°F	degree Fahrenheit
FC	fixed clock
FC2488	Fixed Distributed Data Interface
FDDI	Fiber Distributed Data Interface
FIT	failure in time
F-ON	Forced O+B85n
FTP	File Transfer Protocol
Gbps	gigabits per second
GHz	gigahertz

Table D-1 Acronyms Used in This Guide (continued)

Acronyms	Expansions
GND	Signal Ground
GUI	graphical user interface
h	hour
HS	high speed
HS-FC1062	high speed with 1062-Mbps fixed clock
HS-FC1062-CL	high speed with 1062-Mbps fixed clock for coupling link
HS-FC622	high speed with 622-Mbps fixed clock
HS-LC-MC	high speed with low-speed multiclock
HS-MC1062/1244	high-speed multiclock 1062/1244 Mbps
HS-T	high-speed transparent
HW/SW	hardware/software
IANA	Internet Assigned Numbers Authority
ICANN	Internet Corporation for Assigned Names and Numbers
ICMP	Internet Control Message Protocol
INNC	inter-NEMI network connection
IP	Internet Protocol
ITU-T	International Telecommunication Union Telecommunication Standardization Sector
kbps	kilobits per second
kg	kilogram
km	kilometer
L	local
LAN	local area network

Table D-1 Acronyms Used in This Guide (continued)

Acronyms	Expansions
lb	pound
LED	light emitting diode
Linux	Linus Torvald's UNIX
MHz	megahertz
L/R	local receiver
LS	low-speed
LS-MC	low-speed multiclock
LS-T	low-speed transparent
L/T	local transmitter
M	common transmitter input (RSM)
M	multimode (on labels)
MAN	metropolitan area network
Mbps	megabits per second
MC	multiclock
MHz	megahertz
mi	mile
MIB	Management Information Base
mm	millimeter
MiniSC	type of connector with physiccal contact (also know as MUPC)
ms	millisecond
MTBF	meantime between failures
MTTR	meantime to repair
MU/APC	type of connector with angled physical contact (8°)
MUPC	type of connector with physical contact
MUX	multiplexer module

Table D-1 Acronyms Used in This Guide (continued)

Acronyms	Expansions
N	newton
nc	not connected
NCC	network control center
NEMI	network element management interface
nm	nanometer
NMS	network management system
NTP	Network Time Protocol
o/e	optical to electrical conversion
OADM	optical add/drop multiplexer
OC A130-n	optical carrier (SONET) standard: ANSI/T1.105.06
OC-1	optical carrier level 1
OC-12	optical carrier level 12 (2488.32 Mbps)
OC-3	optical carrier level 3 (155.52 Mbps)
OC-48	optical carrier level 48 (2488.32 Mbps)
OS	operating system
OTDR	optical time domain reflectometer
OTM	optical terminal multiplexer
PDL	polarization dependent loss
PDU	power distribution unit
PLD	programmable logic device
PMD	polarization mode dispersion
PPP	Point-to-Point Protocol
ps	picosecond
PSM	power supply module
R	remote

Table D-1 Acronyms Used in This Guide (continued)

Acronyms	Expansions
R/R	remote receiver
R/T	remote transmitter
RFC	Request For Comments
RI	ring indicator
RSM	remote switch module
RTS	Request To Send
Rx	receiver
RxD	Receive Data
S	single-mode
SELV	safety extra low voltage
SDH	Synchronous Digital Hierarchy
SM	single-mode
SNMP	Simple Network Management Protocol
STM-1	Level 1 (51.840 Mbps)
STM-16	Level 16 (622.080 Mbps)
STM-4	Level 4 (155.520 Mbps)
STM-64	Level 64 (2488.320 Mbps)
STM-n	Synchronous Transport Module - level n
T	transparent
TCP/IP	Transmission Control Protocol/Internet Protocol
TDM	time division multiplexing
TDM4E	TDM Channel Module 4 x ESCON
Telnet	Telecommunication Network
Tx	transmitter
TxD	transmit data

Table D-1 Acronyms Used in This Guide (continued)

Acronyms	Expansions
UART	Universal Asynchronous Receiver Transmitter
UDP	User Datagram Protocol
UNIX	a multiuser, multitasking operating system
UTC	Universal Time Coordinated
UTP Ethernet	unshielded twisted pair Ethernet
vi	visual interface
WAN	wide area network
WCM	wavelength channel module
WDM	wavelength division multiplexing

APPENDIX E

Unit Maintenance and Network Record

The Cisco Metro 1500 series system is made up of a primary chassis and one to three extension chassis. The unit maintenance and network record contained in this appendix allows you to maintain a record of your system hardware and network configuration information.

Primary Chassis

Model Number(s) of Unit(s)	
Serial Number(s) of Units(s)	
Installation Site	
Network Control Center (NCC)	

WCMs or TDM4Es

Position in Chassis	Model Number	Serial Number
1		
2		
3		
4		
5		
6		
7		
8		

Module	Module Number	Serial Number
MUX		
DMX		
RSM (opt)		
NEMI		

Network Details

Host Name	
Domain Name	
IP Address	
IP Netmask	
IP Broadcast Address	

Gateway / Router Address	
Domain Name Server Address	
Modem Telephone Number	
PPP IP Number	
IP Number of PPP Client	

Extension Chassis A

Model Number	
Serial Number	

WCMs or TDM4Es

Position in Chassis	Model Number	Serial Number
1		
2		
3		
4		
5		
6		
7		
8		

Module	Model Number	Serial Number
MUX		
DMX		
BSM		
DEMI		

Extension Chassis B

Model Number	
Serial Number	

WCMs or TDM4Es

Position in Chassis	Model Number	Serial Number
1		
2		
3		
4		
5		
6		
7		
8		

Module	Model Number	Serial Number
MUX		
DMX		
NEMI		

Network Details

Host Name	
Domain Name	
IP Address	
IP Netmask	
IP Broadcast Address	
Gateway / Router Address	
Domain Name Server Address	
Modem Telephone Number	
PPP IP Number	
IP Number of PPP Client	

Extension Chassis C

Model Number	
Serial Number	

WCMs or TDM4Es

Position in Chassis	Model Number	Serial Number
1		
2		
3		
4		
5		
6		
7		
8		

Module	Model Number	Serial Number
MUX		
DMX		
NEMI		

Extension Chassis D

Model Number	
Serial Number	

TDM4Es

Position in Chassis	Model Number	Serial Number
1		
2		
3		
4		

Module	Model Number	Serial Number
MUX		
DMX		
NEMI		

Network Details

Host Name	
Domain Name	
IP Address	
IP Netmask	

IP Broadcast Address	
Gateway / Router Address	
Domain Name Server Address	
Modem Telephone Number	
PPP IP Number	
IP Number of PPP Client	

Extension Chassis E

Model Number	
Serial Number	

TDM4Es

Position in Chassis	Model Number	Serial Number
1		
2		
3		
4		

Module	Model Number	Serial Number
NEMI		

Extension Chassis F

Model Number	
Serial Number	

TDM4Es

Position in Chassis	Model Number	Serial Number
1		
2		
3		
4		

Module	Model Number	Serial Number
MUX		
DMX		
NEMI		

Network Details

Host Name	
Domain Name	
IP Address	
IP Netmask	

IP Broadcast Address	
Gateway / Router Address	
Domain Name Server Address	
Modem Telephone Number	
PPP IP Number	
IP Number of PPP Client	

Extension Chassis G

Model Number	
Serial Number	

WCMs or TDM4Es

Position in Chassis	Model Number	Serial Number
1		
2		
3		
4		

Module	Model Number	Serial Number
NEMI		

Comments

APPENDIX F

Translated Safety Warnings

This appendix contains the translations of the following safety warnings, which are included in 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 **Warnhinweis Bevor Sie das System installieren, in Betrieb setzen oder warten, lesen Sie die *Anleitung zur Standortvorbereitung und Sicherheitshinweise*. Dieses Handbuch enthält wichtige Informationen zur Sicherheit, mit denen Sie sich vor dem Verwenden des Systems vertraut machen sollten.**

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.**

Advarsel **Før du installerer, tar i bruk eller utfører vedlikehold på systemet, må du lese *Veiledning for stedsklargjøring og sikkerhet*. Denne håndboken inneholder viktig informasjon om sikkerhet som du bør være kjent med før du begynner å arbeide med systemet.**

Aviso **Antes de instalar, funcionar com, ou prestar assistência ao sistema, leia o *Guia de Preparação e Segurança do Local*. Este guia contém informações de segurança importantes que deve conhecer antes de trabalhar com o sistema.**

¡Advertencia! **Antes de instalar, manejar o arreglar el sistema, le aconsejamos que consulte la *Guía de prevención y preparación de una instalación*. Esta guía contiene importante información para su seguridad que debe saber antes de comenzar a trabajar con el sistema.**

Varning! **Innan du installerar, använder eller utför service på systemet ska du läsa *Förberedelser och säkerhet Handbok*. Denna handbok innehåller viktig säkerhetsinformation som du bör känna till innan du arbetar med systemet.**

Power Cord Warning

Warning **This unit might have more than one power cord. To reduce the risk of electric shock, disconnect the two power supply cords before servicing the unit.**

Waarschuwing **Dit toestel kan meer dan één netsnoer hebben. Om het risico van een elektrische schok te verminderen, dient u de stekkers van de twee netsnoeren uit het stopcontact te halen voordat u het toestel een servicebeurt geeft.**

Varoitus **Tässä laitteessa saattaa olla useampi kuin yksi virtajohto. Irrota molemmat virtalähteestä tulevat johtimet ennen laitteen huoltamista, jotta vältät sähköiskun vaaran.**

Attention **Il est possible que cette unité soit munie de plusieurs cordons d'alimentation. Pour éviter les risques d'électrocution, débrancher les deux cordons d'alimentation avant de réparer l'unité.**

Warnung **Diese Einheit hat möglicherweise mehr als ein Netzkabel. Zur Verringerung der Stromschlaggefahr trennen Sie beide Netzgerätekabel ab, bevor Sie die Einheit warten.**

Avvertenza **Questa unità potrebbe essere dotata di più di un cavo di alimentazione. Per ridurre il rischio di scossa elettrica, scollegare i due cavi di alimentazione prima di procedere alla manutenzione dell'unità.**

Advarsel **Denne enheten kan være utstyrt med mer enn én strømledning. Koble fra de to strømledningene før det utføres reparasjonsarbeid på enheten for å redusere faren for elektriske støt.**

Aviso **Esta unidade poderá ter mais do que um cabo de alimentação. Para reduzir o risco de choque eléctrico, desligue os dois cabos de alimentação antes de efectuar reparações na unidade.**

¡Advertencia! **Puede ser que este equipo posea más de un cable de alimentación. Para reducir el riesgo de descarga eléctrica, desenchufar los dos cables antes de proceder al mantenimiento de la unidad.**

Varning! **Denna enhet kan vara försedd med mer än en nätsladd. För att minska risken för elektriska stötar skall båda nätsladdarna dras ur innan du utför underhållsarbete på enheten.**

Restricted Area Warning

Warning **This unit is intended for installation in restricted access areas. A restricted access area is where access can only be gained by service personnel through the use of a special tool, lock and key, or other means of security, and is controlled by the authority responsible for the location.**

Waarschuwing **Dit toestel is bedoeld voor installatie op plaatsen met beperkte toegang. Een plaats met beperkte toegang is een plaats waar toegang slechts door servicepersoneel verkregen kan worden door middel van een speciaal instrument, een slot en sleutel, of een ander veiligheidsmiddel, en welke beheerd wordt door de overheidsinstantie die verantwoordelijk is voor de locatie.**

Varoitus **Tämä laite on tarkoitettu asennettavaksi paikkaan, johon pääsy on rajoitettua. Paikka, johon pääsy on rajoitettua, tarkoittaa paikkaa, johon vain huoltohenkilöstö pääsee jonkin erikoistyökalun, lukkoon sopivan avaimen tai jonkin muun turvalaitteen avulla ja joka on paikasta vastuussa olevien toimivaltaisten henkilöiden valvoma.**

Attention **Cet appareil est à installer dans des zones d'accès réservé. Ces dernières sont des zones auxquelles seul le personnel de service peut accéder en utilisant un outil spécial, un mécanisme de verrouillage et une clé, ou tout autre moyen de sécurité. L'accès aux zones de sécurité est sous le contrôle de l'autorité responsable de l'emplacement.**

Warnung **Diese Einheit ist zur Installation in Bereichen mit beschränktem Zutritt vorgesehen. Ein Bereich mit beschränktem Zutritt ist ein Bereich, zu dem nur Wartungspersonal mit einem Spezialwerkzeugs, Schloß und Schlüssel oder anderer Sicherheitsvorkehrungen Zugang hat, und der von dem für die Anlage zuständigen Gremium kontrolliert wird.**

Avvertenza **Questa unità deve essere installata in un'area ad accesso limitato. Un'area ad accesso limitato è un'area accessibile solo a personale di assistenza tramite un'attrezzo speciale, lucchetto, o altri dispositivi di sicurezza, ed è controllata dall'autorità responsabile della zona.**

Advarsel **Denne enheten er laget for installasjon i områder med begrenset adgang. Et område med begrenset adgang gir kun adgang til servicepersonale som bruker et spesielt verktøy, lås og nøkkel, eller en annen sikkerhetsanordning, og det kontrolleres av den autoriteten som er ansvarlig for området.**

Aviso **Esta unidade foi concebida para instalação em áreas de acesso restrito. Uma área de acesso restrito é uma área à qual apenas tem acesso o pessoal de serviço autorizado, que possua uma ferramenta, chave e fechadura especial, ou qualquer outra forma de segurança. Esta área é controlada pela autoridade responsável pelo local.**

¡Advertencia! **Esta unidad ha sido diseñada para instalarse en áreas de acceso restringido. Área de acceso restringido significa un área a la que solamente tiene acceso el personal de servicio mediante la utilización de una herramienta especial, cerradura con llave, o algún otro medio de seguridad, y que está bajo el control de la autoridad responsable del local.**

Varning! **Denna enhet är avsedd för installation i områden med begränsat tillträde. Ett område med begränsat tillträde får endast tillträdas av servicepersonal med ett speciellt verktyg, lås och nyckel, eller annan säkerhetsanordning, och kontrolleras av den auktoritet som ansvarar för området.**

Class 1 Laser Product Warning

Invisible laser radiation when this component is opened and the preregulation is disabled. Do not look into the laser beam.

Warning	**Class 1 Laser Product**
Waarschuwing	**Waarschuwing voor klasse 1 laserprodukten**
Varoitus	**Lasertuote luokka 1**
Avertissement	**Produits Laser Class 1**
Warnung	**Produkt-Warnhinweis zu Lasergeräten der Klasse 1**
Avvertenza	**Prodotto Laser di Classe 1**
Advarsel!	**Advarsel for laserprodukter i klasse 1**
Aviso	**Aviso sobre produtos a laser da Classe 1**
¡Advertencia!	**É Aviso sobre producto láser de Clase 1**
Varning!	**Varning beträffande laserprodukt, klass 1**

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 vaurioitumisen sähköstaattisen 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 Zur Vermeidung einer Beschädigung der Karte durch elektrostatische Entladung während dieses Verfahrens ein Erdungsband am Handgelenk tragen. Bei Berührung der Rückwand mit der Hand oder einem metallenen Werkzeug besteht Elektroschockgefahr.

Avvertenza Durante questa procedura, indossare bracciali antistatici per evitare danni alla scheda causati da un'eventuale scarica elettrostatica. Non toccare direttamente il pannello delle connessioni, né con le mani né con un qualsiasi utensile metallico, perché esiste il pericolo di folgorazione.

Advarsel **Bruk jordingsarmbånd under prosedyren for å unngå ESD-skader på kortet. Unngå direkte berøring av bakplanet med hånden eller metallverktøy, slik at di ikke får elektrisk støt.**

Aviso **Durante este procedimento e para evitar danos ESD causados à placa, use fitas de ligação à terra para os pulsos. Para evitar o risco de choque eléctrico, não toque directamente na parte posterior com a mão ou com qualquer ferramenta metálica.**

¡Advertencia! **Usartiras conectadas a tierra en las muñecas durante este procedimiento para evitar daños en la tarjeta causados por descargas electrostáticas. No tocar el plano posterior con las manos ni con ninguna herramienta metálica, ya que podría producir un choque eléctrico.**

Varning! **Använd jordade armbandsremmar under denna procedur för att förhindra elektrostatisk skada på kortet. Rör inte vid baksidan med handen eller metallverktyg då detta kan orsaka elektrisk stöt.**

Main Disconnecting Device

Warning **This warning applies only to units equipped with DC input power supplies. Wire the DC power supply using the appropriate lugs at the wiring end. The proper wiring sequence is ground to ground, positive to positive (line to L), and negative to negative (neutral to N). Note that the ground wire should always be connected first and disconnected last.**

Waarschuwing **De combinatie van de stekker en het elektrisch contactpunt moet te allen tijde toegankelijk zijn omdat deze het hoofdmechanisme vormt voor verbreking van de aansluiting.**

Varoitus **Pistoke/liitinkohta toimii pääkatkaisumekanismina. Pääsy siihen on pidettävä aina esteettömänä.**

Attention **La combinaison de prise de courant doit être accessible à tout moment parce qu'elle fait office de système principal de déconnexion.**

Warnung **Der Netzkabelanschluß am Gerät muß jederzeit zugänglich sein, weil er als primäre Ausschaltvorrichtung dient.**

Avvertenza **Il gruppo spina-presa deve essere sempre accessibile, poiché viene utilizzato come dispositivo di scollegamento principale.**

Advarsel **Kombinasjonen støpsel/uttak må alltid være tilgjengelig ettersom den fungerer som hovedfrakoplingsenhet.**

Aviso **A combinação ficha-tomada deverá ser sempre acessível, porque funciona como interruptor principal.**

¡Advertencia! **El conjunto de clavija y toma ha de encontrarse siempre accesible ya que hace las veces de dispositivo de desconexión principal.**

Varning! **Man måste alltid kunna komma åt stickproppen i uttaget, eftersom denna koppling utgör den huvudsakliga frånkopplingsanordningen.**

Installation Warning

Warning	**Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**
Waarschuwing	**Deze apparatuur mag alleen worden geïnstalleerd, vervangen of hersteld door bevoegd geschoold personeel.**
Varoitus	**Tämän laitteen saa asentaa, vaihtaa tai huoltaa ainoastaan koulutettu ja laitteen tunteva henkilökunta.**
Attention	**Il est vivement recommandé de confier l'installation, le remplacement et la maintenance de ces équipements à des personnels qualifiés et expérimentés.**
Warnung	**Das Installieren, Ersetzen oder Bedienen dieser Ausrüstung sollte nur geschultem, qualifiziertem Personal gestattet werden.**
Avvertenza	**Questo apparato può essere installato, sostituito o mantenuto unicamente da un personale competente.**
Advarsel	**Bare opplært og kvalifisert personell skal foreta installasjoner, utskiftninger eller service på dette utstyret.**
Aviso	**Apenas pessoal treinado e qualificado deve ser autorizado a instalar, substituir ou fazer a revisão deste equipamento.**
¡Advertencia!	**Solamente el personal calificado debe instalar, reemplazar o utilizar este equipo.**
Varning!	**Endast utbildad och kvalificerad personal bör få tillåtelse att installera, byta ut eller reparera denna utrustning.**

DC Power Supply Wiring Warning

Warning **This warning applies only to units equipped with DC input power supplies. Wire the DC power supply using the appropriate lugs at the wiring end. The proper wiring sqequence is ground to ground, positive to positive (line to L), and negative to negative (neutral to N). Note that the ground wire should always be connected first and disconnected last.**

Waarschuwing **Deze waarschuwing is uitsluitend van toepassing op eenheden met gelijkstroomvoeding. Voor aansluiting van de gelijkstroomvoeding moeten op de bedradingsuiteinden de juiste kabelschoentjes gebruikt worden. De juiste bedradingsvolgorde is aarde naar aarde, positief naar positief (lijn naar L) en negatief naar negatief (neutraal naar N). Let op: de aardedraad moet altijd het eerst aangesloten en het laatst losgemaakt worden.**

Varoitus **Tämä varoitus koskee ainoastaan laitteita, jotka käyttävät tasavirtalähteitä. Kytke tasavirtalähde asianmukaisia johtojen päissä olevia napakenkiä käyttäen. Johdot on kiinnitettävä maadoitus maadoitukseen, positiivinen positiiviseen (linja L:ään) ja negatiivinen negatiiviseen (neutraali N:ään). Huomaa, että maadoitusjohto on kytkettävä aina ensin ja irrotettava viimeisenä.**

Attention **(Cet avertissement concerne uniquement les équipements disposant de bloc d'alimentation CC.) Connectez le bloc d'alimentation CC à l'aide des attaches à l'extrémité des câbles, selon la séquence suivante : terre sur terre, positif sur positif (ligne sur L), négatif sur négatif (neutre sur N). Le câble de mise à la terre doit toujours être connecté en premier et déconnecté en dernier.**

Warnung **Diese Warnung gilt nur für Geräte, die mit Gleichstrom-Eingangsstromzufuhren ausgestattet sind. Schließen Sie die Gleichstrom-Stromzufuhr unter Verwendung der dafür vorgesehenen Kabelmuffen an. Die korrekte Reihenfolge beim Verkabeln ist: Erdung an Erdung, positiv an positiv (Leitung an L) und negativ an negativ (neutral an N). Achten Sie darauf, daß das Erdungskabel stets als erstes angeschlossen und als letztes unterbrochen wird.**

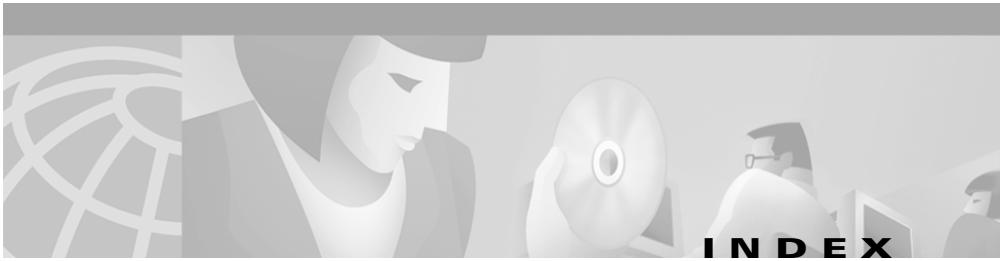
Avvertenza **Questa avvertenza concerna unicamente le unità attrezzate di un alimentatore elettrico di input DC. Cablate l'alimentatore elettrico DC utilizzando le capocorde. L'ordine di cablaggio deve essere terra-terra, positivo-positivo (linea a L), e negativo-negativo (Neutro a N). Il cavo terra dovrebbe sempre essere connesso per prima e staccato per ultimo.**

Advarsel **Denne advarselen gjelder bare for enheter som er utstyrt med likestrømsforsyninger. Koble ledningen på likestrømsforsyningen med passende kabelsko på enden av ledningen. Riktig ledningssekvens er jord til jord, positiv til positiv (linje til L) og negativ til negativ (nøytral til N). Legg merke til at jordledningen alltid skal kobles først og frakobles sist.**

Aviso **Este aviso refere-se apenas a unidades equipadas com uma fonte de alimentação de Corrente Contínua. Ligue a fonte de alimentação de Corrente Contínua usando as presilhas que se encontram na extremidade da cablagem. A sequência correcta da cablagem é de ligação terra a terra, positivo com positivo (alinhe com o L), e negativo com negativo (neutral com o N). De notar que o cabo de ligação à terra deverá ser sempre conectado em primeiro lugar e desconectado por último.**

¡Advertencia! **Este aviso se refiere solamente a las unidades de corriente continua. Cablee la corriente continua usando las orejetas adecuadas al final del cable. La secuencia de cableaje es la siguiente: de tierra a tierra, positivo a positivo (línea a L), y negativo a negativo (neutro a N). El cable de tierra debería ser lo primero en conectar y lo último en desconectar.**

Varning! **Denna varning gäller endast enheter som är försedda med likströmförsörjningsenheter. Anslut likströmsförsörjningsenhetens ledningar med användning av lämpliga fästen vid ledningsändarna. Korrekt ledningsdragningsordning är jord till jord, positiv till positiv (linje till L) och negativ till negativ (neutral till N). Observera att jordledningen alltid måste anslutas först och kopplas ifrån sist.**



Numerics

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

U

V

W