



Cisco Wide Area Virtualization Engine 274 and 474 Hardware Installation Guide

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Americas Headquarters

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

Text Part Number: OL-17739-01

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CONTENTS

Preface ix

CHAPTER 1

Introducing the Cisco Wide Area Virtualization Engine 1-1

Supported Products 1-1

Hardware Features 1-2

Front Panel Controls and LEDs 1-2

Location of Ports and Connectors 1-3

CHAPTER 2

Preparing to Install the Wide Area Virtualization Engine 2-1

Safety Warnings 2-1

Safety Guidelines 2-4

General Precautions 2-4

System Reliability Considerations 2-6

Protecting Against Electrostatic Discharge 2-7

CHAPTER 3

Installing the Wide Area Virtualization Engine 3-1

Installing the WAVE Appliance on a Tabletop 3-2

Installing the WAVE Appliance on a Wall 3-2

Installing the WAVE Appliance in an Equipment Rack 3-5

Rack-Mounting Considerations 3-5

Rack Requirements 3-6

Connecting Cables 3-6

Connecting Power and Booting the System 3-6

Checking the LEDs 3-7

Removing or Replacing a WAVE Appliance 3-7

CHAPTER 4

WAVE Inline Network Adapter 4-1

Inline Network Adapter Description 4-1

Ports and LED Indicators 4-3

Inline Network Adapter Cabling Requirements 4-4

Installation Scenarios and Cabling Examples for Fast Ethernet Connections 4-7

CHAPTER 5

Troubleshooting the System Hardware 5-1

Identifying System Problems 5-2

Checking Connections and Switches 5-3

Troubleshooting the Ethernet Controller 5-4

 Network Connection Problems 5-4

 Ethernet Controller Troubleshooting Chart 5-5

Undetermined Problems 5-6

Problem-Solving Tips 5-7

Symptoms and Solutions 5-8

Power-On Self Test (POST) 5-12

 POST Overview 5-12

 POST Numeric Codes and Text Messages 5-13

 Interpreting POST Diagnostic Front Panel LEDs and Beep Codes 5-16

APPENDIX A

Wide Area Virtualization Engine Hardware Specifications A-1

Appliance Specifications A-1

Inline Adapter Specifications A-4

APPENDIX B**Maintaining the Wide Area Virtualization Engine B-1**Maintaining Your Site Environment **B-1**Temperature **B-2**Humidity **B-3**Altitude **B-3**Dust and Particles **B-4**Corrosion **B-4**Electrostatic Discharge **B-4**Electromagnetic and Radio Frequency Interference **B-5**Magnetism **B-5**Shock and Vibration **B-6**Power Source Interruptions **B-6**Using Power Protection Devices **B-7**Surge Protectors **B-7**Line Conditioners **B-8**Uninterruptible Power Supplies **B-8**

INDEX



Preface

This preface describes the purpose of the *Cisco Wide Area Virtualization Engine 274 and 474 Hardware Installation Guide*, who should read it, how it is organized, and its document conventions.

This preface contains the following sections:

- [Purpose, page ix](#)
- [Audience, page x](#)
- [Organization, page x](#)
- [Conventions, page xi](#)
- [Related Documentation, page xviii](#)
- [Obtaining Documentation, Obtaining Support, and Security Guidelines, page xix](#)

Purpose

This installation guide explains how to prepare your site for installation, how to install a Wide Area Virtualization Engine (WAVE) appliance, and how to maintain and troubleshoot the system hardware. After completing the hardware installation procedures covered in this guide, you will then use the appropriate related publications to configure your system. (See the [“Related Documentation” section on page xviii.](#))

Audience

To use this installation guide, you should be familiar with internetworking equipment and cabling, and have a basic knowledge of electronic circuitry and wiring practices.

To complete the installation, including the software configuration for your WAVE appliance and for the router that works with the WAVE appliance, you should be familiar with basic networking principles, router configuration, and web page protocols.



Warning

Only trained and qualified personnel should be allowed to install, replace, or service this equipment. Statement 1030

Organization

This guide includes the following chapters:

Chapter	Title	Description
Chapter 1	Introducing the Cisco Wide Area Virtualization Engine	Describes the physical properties and provides a functional overview of the Cisco Wide Area Virtualization Engine 274 and 474.
Chapter 2	Preparing to Install the Wide Area Virtualization Engine	Describes safety considerations and gives an overview of the installation and procedures that you should perform <i>before</i> the actual installation.
Chapter 3	Installing the Wide Area Virtualization Engine	Describes how to install the hardware and connect the external network interface cables.
Chapter 4	WAVE Inline Network Adapter	Describes the Cisco WAVE inline network adapter and how to use it.

Chapter	Title	Description
Chapter 5	Troubleshooting the System Hardware	Describes troubleshooting procedures for the hardware installation.
Appendix A	Wide Area Virtualization Engine Hardware Specifications	Gives a summary of the hardware features and specifications.
Appendix B	Maintaining the Wide Area Virtualization Engine	Describes how to maintain the Wide Area Virtualization Engine.

Conventions

Command descriptions use the following conventions:

Convention	Description
boldface font	Commands and keywords are in boldface .
<i>italic</i> font	Variables for which you supply values are in <i>italics</i> .
[]	Elements in square brackets are optional.
{ x y z }	Alternative keywords are grouped in braces and separated by vertical bars.
[x y z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
string	A nonquoted set of characters. Do not use quotation marks around the string, or the string will include the quotation marks.

Screen examples use the following conventions:

Convention	Description
<i>screen font</i>	Terminal sessions and information the system displays are in <i>screen font</i> .
boldface screen font	Information you must enter is in boldface screen font .
<i>italic screen font</i>	Variables for which you supply values are in <i>italic screen font</i> .
^	The symbol ^ represents the key labeled Control—for example, the key combination ^D in a screen display means hold down the Control key while you press the D key.
< >	Nonprinting characters, such as passwords, are in angle brackets.
[]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Notes, cautionary statements, and safety warnings use these conventions:



Note

Means *reader take note*. Notes contain helpful suggestions or references to materials not contained in this manual.



Caution

Means *reader be careful*. You are capable of doing something that might result in equipment damage or loss of data.

**Warning**

IMPORTANT SAFETY INSTRUCTIONS

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

SAVE THESE INSTRUCTIONS

Figyelem

FONTOS BIZTONSÁGI ELOÍRÁSOK

Ez a figyelmeztető jel veszélyre utal. Sérülésveszélyt rejtő helyzetben van. Mielőtt bármely berendezésen munkát végezte, legyen figyelemmel az elektromos áramkörök okozta kockázatokra, és ismerkedjen meg a szokásos balesetvédelmi eljárásokkal. A kiadványban szereplő figyelmeztetések fordítása a készülékhez mellékelt biztonsági figyelmeztetések között található; a fordítás az egyes figyelmeztetések végén látható szám alapján kereshető meg.

ORIZZE MEG EZEKET AZ UTASÍTÁSOKAT!

Предупреждение

ВАЖНЫЕ ИНСТРУКЦИИ ПО СОБЛЮДЕНИЮ ТЕХНИКИ БЕЗОПАСНОСТИ

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

СОХРАНИТЕ ЭТИ ИНСТРУКЦИИ

警告

重要的安全性说明

此警告符号代表危险。您正处于可能受到严重伤害的工作环境中。在您使用设备开始工作之前，必须充分意识到触电的危险，并熟练掌握防止事故发生的标准工作程序。请根据每项警告结尾提供的声明号码来找到此设备的安全性警告说明的翻译文本。

请保存这些安全性说明

警告

安全上の重要な注意事項

「危険」の意味です。人身事故を予防するための注意事項が記述されています。装置の取り扱い作業を行うときは、電気回路の危険性に注意し、一般的な事故防止策に留意してください。警告の各国語版は、各注意事項の番号を基に、装置に付属の「Translated Safety Warnings」を参照してください。

これらの注意事項を保管しておいてください。

주의 중요 안전 지침

이 경고 기호는 위험을 나타냅니다. 작업자가 신체 부상을 일으킬 수 있는 위험한 환경에 있습니다. 장비에 작업을 수행하기 전에 전기 회로와 관련된 위험을 숙지하고 표준 작업 관례를 숙지하여 사고를 방지하십시오. 각 경고의 마지막 부분에 있는 경고문 번호를 참조하여 이 장치와 함께 제공되는 번역된 안전 경고문에서 해당 번역문을 찾으십시오.

이 지시 사항을 보관하십시오.

تحذير

إرشادات الأمان الهامة

يوضح رمز التحذير هذا وجود خطر. وهذا يعني أنك متواجد في مكان قد ينتج عنه التعرض لإصابات. قبل بدء العمل، احذر مخاطر التعرض للصدمات الكهربائية وكن على علم بالإجراءات القياسية للحيلولة دون وقوع أي حوادث. استخدم رقم البيان الموجود في آخر كل تحذير لتحديد مكان ترجمته داخل تحذيرات الأمان المترجمة التي تأتي مع الجهاز. قم بحفظ هذه الإرشادات

Upozorenje VAŽNE SIGURNOSNE NAPOMENE

Ovaj simbol upozorenja predstavlja opasnost. Nalazite se u situaciji koja može prouzročiti tjelesne ozljede. Prije rada s bilo kojim uređajem, morate razumjeti opasnosti vezane uz električne sklopove, te biti upoznati sa standardnim načinima izbjegavanja nesreća. U prevedenim sigurnosnim upozorenjima, priloženima uz uređaj, možete prema broju koji se nalazi uz pojedino upozorenje pronaći i njegov prijevod.

SAČUVAJTE OVE UPUTE

Upozornění **DŮLEŽITÉ BEZPEČNOSTNÍ POKYNY**

Tento upozorňující symbol označuje nebezpečí. Jste v situaci, která by mohla způsobit nebezpečí úrazu. Před prací na jakémkoliv vybavení si uvědomte nebezpečí související s elektrickými obvody a seznamte se se standardními opatřeními pro předcházení úrazům. Podle čísla na konci každého upozornění vyhledejte jeho překlad v přeložených bezpečnostních upozorněních, která jsou přiložena k zařízení.

USCHOVEJTE TYTO POKYNY

Προειδοποίηση **ΣΗΜΑΝΤΙΚΕΣ ΟΔΗΓΙΕΣ ΑΣΦΑΛΕΙΑΣ**

Αυτό το προειδοποιητικό σύμβολο σημαίνει κίνδυνο. Βρίσκεστε σε κατάσταση που μπορεί να προκαλέσει τραυματισμό. Πριν εργαστείτε σε οποιοδήποτε εξοπλισμό, να έχετε υπόψη σας τους κινδύνους που σχετίζονται με τα ηλεκτρικά κυκλώματα και να έχετε εξοικειωθεί με τις συνήθεις πρακτικές για την αποφυγή ατυχημάτων. Χρησιμοποιήστε τον αριθμό δήλωσης που παρέχεται στο τέλος κάθε προειδοποίησης, για να εντοπίσετε τη μετάφρασή της στις μεταφρασμένες προειδοποιήσεις ασφαλείας που συνοδεύουν τη συσκευή.

ΦΥΛΑΞΤΕ ΑΥΤΕΣ ΤΙΣ ΟΔΗΓΙΕΣ

אזהרה

הוראות בטיחות חשובות

סימן אזהרה זה מסמל סכנה. אתה נמצא במצב העלול לגרום לפציעה. לפני שתעבוד עם ציוד כלשהו, עליך להיות מודע לסכנות הכרוכות במעגלים חשמליים ולהכיר את הנהלים המקובלים למניעת תאונות. השתמש במספר ההוראה המסופק בסופה של כל אזהרה כדי לאתר את התרגום באזהרות הבטיחות המתורגמות שמצורפות להתקן.

שמור הוראות אלה

Opomena **ВАЖНИ БЕЗБЕДНОСНИ НАПАТСТВИЈА**
Симболот за предупредување значи опасност. Се наоѓате во ситуација што може да предизвика телесни повреди. Пред да работите со опремата, бидете свесни за ризикот што постои кај електричните кола и треба да ги познавате стандардните постапки за спречување на несреќни случаи. Искористете го бројот на изјавата што се наоѓа на крајот на секое предупредување за да го најдете неговиот период во преведените безбедносни предупредувања што се испорачани со уредот.
ЧУВАЈТЕ ГИ ОБИЕ НАПАТСТВИЈА

Ostrzeżenie **WAŻNE INSTRUKCJE DOTYCZĄCE BEZPIECZEŃSTWA**

Ten symbol ostrzeżenia oznacza niebezpieczeństwo. Zachodzi sytuacja, która może powodować obrażenia ciała. Przed przystąpieniem do prac przy urządzeniach należy zapoznać się z zagrożeniami związanymi z układami elektrycznymi oraz ze standardowymi środkami zapobiegania wypadkom. Na końcu każdego ostrzeżenia podano numer, na podstawie którego można odszukać tłumaczenie tego ostrzeżenia w dołączonym do urządzenia dokumencie z tłumaczeniami ostrzeżeń.

NINIEJSZE INSTRUKCJE NALEŻY ZACHOWAĆ

Upozornenie **DÔLEŽITÉ BEZPEČNOSTNÉ POKYNY**

Tento varovný symbol označuje nebezpečenstvo. Nachádzate sa v situácii s nebezpečenstvom úrazu. Pred prácou na akomkoľvek vybavení si uvedomte nebezpečenstvo súvisiace s elektrickými obvodmi a oboznámte sa so štandardnými opatreniami na predchádzanie úrazom. Podľa čísla na konci každého upozornenia vyhľadajte jeho preklad v preložených bezpečnostných upozorneniach, ktoré sú priložené k zariadeniu.

USCHOVAJTE SI TENTO NÁVOD

Opozorilo **POMEMBNI VARNOSTNI NAPOTKI**

Ta opozorilni simbol pomeni nevarnost. Nahajate se v situaciji, kjer lahko pride do telesnih poškodb. Preden pričnete z delom na napravi, se morate zavedati nevarnosti udara električnega toka, ter tudi poznati preventivne ukrepe za preprečevanje takšnih nevarnosti. Uporabite obrazložitevno številko na koncu posameznega opozorila, da najdete opis nevarnosti v priloženem varnostnem priročniku.

SHRANITE TE NAPOTKE!

警告

重要安全性指示

此警告符號代表危險，表示可能造成人身傷害。使用任何設備前，請留心電路相關危險，並熟悉避免意外的標準作法。您可以使用每項警告後的聲明編號，查詢本裝置隨附之安全性警告譯文中的翻譯。
請妥善保留此指示

Related Documentation

The WAVE appliance supports the Cisco Wide Area Application Services software (WAAS). The WAVE appliance can function as either a WAAS Central Manager or as an Application Acceleration Engine.

The Cisco WAAS software document set includes the following documents:

- *Release Note for Cisco Wide Area Application Services*
- *Cisco Wide Area Application Services Command Reference*
- *Cisco Wide Area Application Services Quick Configuration Guide*
- *Cisco Wide Area Application Services Configuration Guide*
- *Cisco Wide Area Application Services API Reference*
- *Cisco WAAS Installation and Configuration Guide for Windows on a Virtual Blade*

The documentation for this product also includes the following hardware-related documents:

- *Regulatory Compliance and Safety Information for the Cisco Wide Area Virtualization Engines*

Obtaining Documentation, Obtaining Support, and Security Guidelines

For information on obtaining documentation, obtaining support, providing documentation feedback, security guidelines, and also recommended aliases and general Cisco documents, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

<http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html>



CHAPTER 1

Introducing the Cisco Wide Area Virtualization Engine

This chapter provides a basic functional overview of the Cisco Wide Area Virtualization Engine (WAVE) 274 and 474 appliances and describes the hardware, major components, and front and back panel indicators and controls.

This chapter contains the following sections:

- [Supported Products, page 1-1](#)
- [Hardware Features, page 1-2](#)



Note

Throughout this book, references to the WAVE appliance include the WAVE-274 and WAVE-474 appliances, unless specifically noted otherwise.

Supported Products

The WAVE-274 and WAVE-474 appliances support Cisco Wide Area Application Services (WAAS) software version 4.1.1 and later releases.

Hardware Features

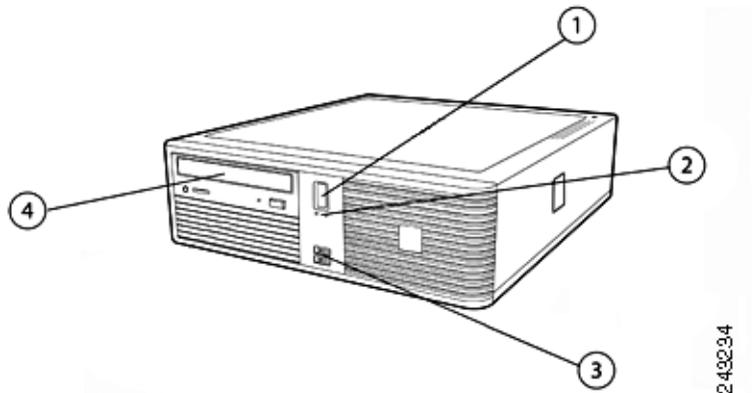
This section illustrates and describes the front and back panel controls, ports, and LED indicators on the WAVE-274 and WAVE-474. It contains the following topics:

- [Front Panel Controls and LEDs, page 1-2](#)
- [Location of Ports and Connectors, page 1-3](#)

Front Panel Controls and LEDs

Figure 1-1 shows the front panel controls and LEDs.

Figure 1-1 WAVE-274 and WAVE-474 Front Panel



1	Power button	3	2 USB 2.0 ports (not supported)
2	LEDs	4	CD/DVD optical drive

The power control button powers up and powers down the system.

**Note**

Any USB connector can be used to connect a keyboard, and the video connector can be used to connect a monitor. The keyboard and monitor are used only during the BIOS boot process for troubleshooting purposes. After the BIOS boots, all input and output for the appliance is by way of the serial console port.

[Table 1-1](#) describes the front panel LEDs and their functions.

Table 1-1 **Front Panel LEDs**

LED	Color	State	Description
Power-on	Green	On	Appliance is powered on.
		Off	AC power is not present. Power supply or LED has failed.
	Red	Flashing	There is a problem with the computer and it is displaying a diagnostic code. See the “Troubleshooting the System Hardware” section on page 5-1.
Hard disk drive activity	Green	Flashing	Hard disk drive is in use.
DVD-ROM drive activity	Green	On	CD/DVD drive is in use.

Location of Ports and Connectors

The WAVE-274 and WAVE-474 appliances support one Ethernet port and one console port. This section contains the following topics:

- [Ethernet Port Connector, page 1-5](#)
- [Console Port Serial Connector, page 1-6](#)

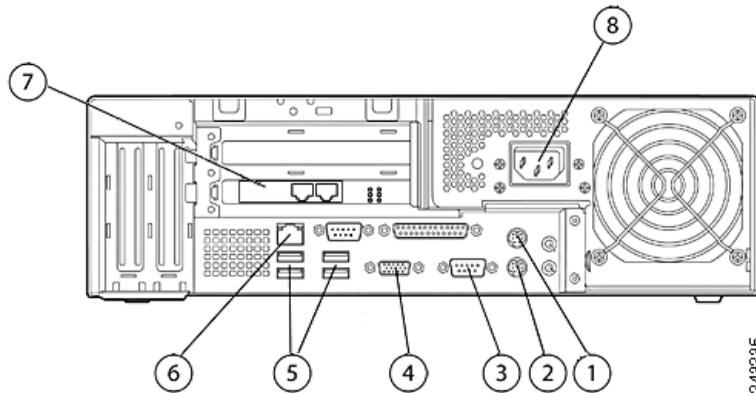
[Figure 1-2](#) shows the back panel ports and connectors.

**Warning**

To avoid electric shock, do not connect safety extra-low voltage (SELV) circuits to telephone-network voltage (TNV) circuits. LAN ports contain SELV circuits, and WAN ports contain TNV circuits. Some LAN and WAN ports both use RJ-45 connectors. Use caution when connecting cables. Statement 1021

Figure 1-2 shows the location of the back panel connectors, and Table 1-2 describes the connector functions.

Figure 1-2 Back Panel LEDs and Connectors



1	PS/2 mouse port (unused)	5	4 USB ports (unused)
2	PS/2 keyboard port (unused)	6	Ethernet port (RJ-45 LAN jack)
3	Console port (RS232 serial COM1 port)	7	Inline adapter (2 ports)
4	VGA port (unused)	8	AC power connector

**Note**

Any USB connector can be used to connect a keyboard, and the video connector can be used to connect a monitor. The keyboard and monitor are used only during the BIOS boot process for troubleshooting purposes. After the BIOS boots, all input and output for the appliance is by way of the serial console port.

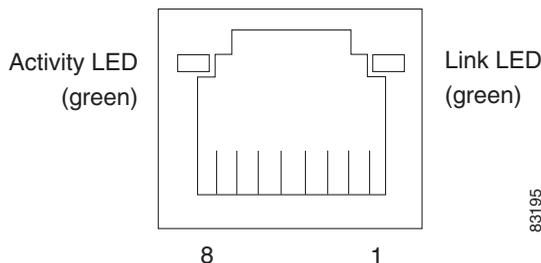
Table 1-2 Back Panel LEDs

LED	Color	State	Description
Ethernet link	Green	On	Active link connection on the 10BASE-T, 100BASE-TX, or 1000BASE-TX interface for the Ethernet port.
Ethernet activity	Green	On	System is transmitting to or receiving signals from the Ethernet LAN that is connected to the Ethernet port.

Ethernet Port Connector

Connect a Category 3, 4, or 5 unshielded twisted-pair cable to the Ethernet connector. 100BASE-TX and 1000BASE-T Fast Ethernet standards require Category 5 or higher cabling. The WAVE appliance has one Ethernet connector (see [Figure 1-3](#)).

The Ethernet controller is integrated on the system board. It provides an interface for connecting to a 10-Mbps, 100-Mbps, or 1-Gbps network and provides full-duplex (FDX) capability, which enables simultaneous transmission and reception of data on the network. If the Ethernet port in the server supports auto negotiation, the controllers detect the data-transfer rate (10BASE-T, 100BASE-TX, or 1000BASE-T) and duplex mode (full duplex or half duplex) of the network and automatically operate at that rate and mode. You do not have to set any jumpers or configure the controller.

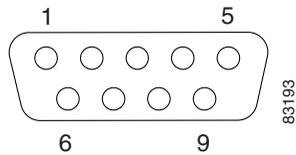
Figure 1-3 Ethernet Port Connector

83195

Console Port Serial Connector

The WAVE-274 and WAVE-474 appliances have one console port (see [Figure 1-4](#)). Use the console port serial connector to connect to a console for accessing the WAAS command-line interface (CLI) or other serial device.

Figure 1-4 Console Port Serial Connector



Note

The WAVE appliance has two serial ports on the rear panel. Be sure to connect your console cable only to the port labeled COM1 or CONSOLE.



CHAPTER 2

Preparing to Install the Wide Area Virtualization Engine

This chapter contains important safety information that you should know before working with the WAVE appliance. Use the guidelines in this chapter to ensure your own personal safety and to help protect your appliance from potential damage.

This chapter contains the following sections:

- [Safety Warnings, page 2-1](#)
- [Safety Guidelines, page 2-4](#)



Note

Read the *Regulatory Compliance and Safety Information for the Cisco Content Networking Product Series* document and the *Site Preparation and Safety Guide* that came with your appliance before you begin the installation.

Safety Warnings

Before you install the WAVE appliance, observe the following safety warnings.



Warning

Only trained and qualified personnel should be allowed to install, replace, or service this equipment. Statement 1030

Safety Warnings

**Warning**

Read the installation instructions before connecting the system to the power source. Statement 1004

**Warning**

Before working on a system that has an on/off switch, turn OFF the power and unplug the power cord. Statement 1

**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. Statement 37

**Warning**

To avoid electric shock, do not connect safety extra-low voltage (SELV) circuits to telephone-network voltage (TNV) circuits. LAN ports contain SELV circuits, and WAN ports contain TNV circuits. Some LAN and WAN ports both use RJ-45 connectors. Use caution when connecting cables. Statement 1021

**Warning**

This product relies on the building's installation for short-circuit (overcurrent) protection. Ensure that a fuse or circuit breaker no larger than 120 VAC, 15A U.S. (240 VAC, 10A international) is used on the phase conductors (all current-carrying conductors). Statement 13

**Warning**

This equipment must be grounded. Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available. Statement 1024

**Warning**

Do not work on the system or connect or disconnect cables during periods of lightning activity. Statement 1001

**Warning**

Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals. Statement 43

**Warning**

When installing or replacing the unit, the ground connection must always be made first and disconnected last. Statement 1046

**Warning**

The safety cover is an integral part of the product. Do not operate the unit without the safety cover installed. Operating the unit without the cover in place will invalidate the safety approvals and pose a risk of fire and electrical hazards. Statement 117

**Warning**

Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place. Statement 1029

**Warning**

There is the danger of explosion if the battery is replaced incorrectly. Replace the battery only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions. Statement 1015

**Warning**

Ultimate disposal of this product should be handled according to all national laws and regulations. Statement 1040

**Warning**

Installation of the equipment must comply with local and national electrical codes. Statement 1074

**Warning**

To prevent bodily injury when mounting or servicing this unit in a rack, you must take special precautions to ensure that the system remains stable. The following guidelines are provided to ensure your safety:

- This unit should be mounted at the bottom of the rack if it is the only unit in the rack.
- When mounting this unit in a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.
- If the rack is provided with stabilizing devices, install the stabilizers before mounting or servicing the unit in the rack. Statement 1006

Safety Guidelines

To reduce the risk of bodily injury, electrical shock, fire, and damage to the equipment, observe the precautions in this section.

This section contains the following topics:

- [General Precautions, page 2-4](#)
- [System Reliability Considerations, page 2-6](#)
- [Protecting Against Electrostatic Discharge, page 2-7](#)

General Precautions

Observe the following general precautions for using and working with the WAVE appliance:

- Observe and follow service markings. Do not service any Cisco product except as explained in your system documentation. Opening or removing covers that are marked with the triangular symbol with a lightning bolt may expose you to electrical shock. Components inside these compartments should be serviced only by a trained and qualified service technician.

- If any of the following conditions occur, unplug the product from the electrical outlet and replace the part or contact your customer service representative:
 - The power cable or plug is damaged.
 - An object has fallen into the product.
 - The product has been exposed to water.
 - The product has been dropped or damaged.
 - The product does not operate correctly when you follow the operating instructions.
- Keep your system components away from radiators and heat sources. Also, do not block cooling vents.
- Do not spill food or liquids on your system components, and never operate the product in a wet environment.
- Do not push any objects into the openings of your system components. Doing so can cause fire or electric shock by shorting out interior components.
- Use the product only with other Cisco-approved equipment.
- Allow the product to cool before removing covers or touching internal components.
- Use the correct external power source. Operate the product only from the type of power source indicated on the electrical ratings label. If you are not sure of the type of power source required, consult your service representative or local power company.
- Use only approved power cables. If you have not been provided with a power cable for your WAVE appliance or for any AC-powered option intended for your system, purchase a power cable that is approved for use in your country. The power cable must be rated for the product and for the voltage and current marked on the product's electrical ratings label. The voltage and current rating of the cable should be greater than the ratings marked on the product.
- To help prevent electric shock, plug the system components and peripheral power cables into properly grounded electrical outlets. These cables are equipped with three-prong plugs to help ensure proper grounding. Do not use adapter plugs or remove the grounding prong from a cable.

- Observe power strip ratings. Make sure that the total ampere rating of all products plugged into the power strip does not exceed 80 percent of the power strip ampere ratings limit.
- Do not use appliance or voltage converters or kits sold for appliances with your product.
- To help protect your system components from sudden, transient increases and decreases in electrical power, use a surge suppressor, line conditioner, or uninterruptible power supply (UPS).
- Position cables and power cords carefully; route cables and the power cord and plug so that they cannot be stepped on or tripped over. Be sure that nothing rests on your system components' cables or power cord.
- Do not modify power cables or plugs. Consult a licensed electrician or your power company for site modifications. Always follow your local or national wiring rules.

System Reliability Considerations

To help ensure proper cooling and system reliability, make sure that the following occurs:

- Each of the drive bays has either a drive or a filler panel installed.
- For rack configurations, make sure that space is available around the appliance to enable the cooling system to work properly. See the documentation that comes with the rack for additional information.
- The appliance cover is in place during normal operation.
- The air baffle cover over the microprocessors remains closed during normal operation.
- The air baffle is installed between the fans and the power supply.
- A removed hot-swappable drive is replaced within 2 minutes of removal.
- Cables for optional adapters are routed according to the instructions provided with the adapters.
- A failed fan is replaced within 48 hours.
- The appliance is powered down and the power cords are disconnected before you open the air baffle cover.

- The air baffle assembly is always installed in the appliance except when you are installing or removing the components that are located under the air baffle cover.
- When the air baffle assembly is installed in the appliance, the air baffle cover is always closed.
- Microprocessor socket 2 always contains either a microprocessor baffle or a microprocessor.

Protecting Against Electrostatic Discharge

Static electricity can harm delicate components inside the appliance. To prevent static damage, discharge static electricity from your body before you touch any of your system's electronic components. You can do so by touching an unpainted metal surface on the chassis.

You can also take the following steps to prevent damage from electrostatic discharge (ESD):

- When unpacking a static-sensitive component from its shipping carton, do not remove the component from the antistatic packing material until you are ready to install the component in your system. Just before unwrapping the antistatic packaging, be sure to discharge static electricity from your body.
- When transporting a sensitive component, first place it in an antistatic container or packaging.
- Handle all sensitive components in a static-safe area. If possible, use antistatic floor pads and workbench pads.
- Handle the device carefully, holding it by its edges or its frame.
- Do not touch solder joints, pins, or exposed printed circuitry.
- Do not leave the device where others can handle and possibly damage the device.
- Take additional care when handling devices during cold weather, because heating reduces indoor humidity and increases static electricity.



CHAPTER 3

Installing the Wide Area Virtualization Engine

This chapter describes how to install a Wide Area Virtualization Engine (WAVE) appliance on a tabletop, on a wall, or in an equipment rack. This chapter contains the following sections:

- [Installing the WAVE Appliance on a Tabletop, page 3-2](#)
- [Installing the WAVE Appliance on a Wall, page 3-2](#)
- [Installing the WAVE Appliance in an Equipment Rack, page 3-5](#)
- [Connecting Cables, page 3-6](#)
- [Connecting Power and Booting the System, page 3-6](#)
- [Checking the LEDs, page 3-7](#)
- [Removing or Replacing a WAVE Appliance, page 3-7](#)

Before you begin the installation, read [Chapter 2, “Preparing to Install the Wide Area Virtualization Engine”](#) and the *Regulatory Compliance and Safety Information for the Cisco Wide Area Virtualization Engine 274 and 474* document.



Warning

Read the installation instructions before connecting the system to the power source. Statement 1004

Installing the WAVE Appliance on a Tabletop

When you install a WAVE appliance on a workbench or tabletop, ensure that the surface is clean and in a safe location and that you have considered the following points:

- The WAVE appliance should be installed off the floor. (Dust that accumulates on the floor is drawn into the interior of the chassis by the cooling fans. Excessive dust inside the WAVE appliance can cause overtemperature conditions and component failures.)
- There must be approximately 19 inches (48.26 cm) of clearance at the front and rear of the WAVE appliance for accessing network cables or equipment.
- The front should be completely clear. Leave 0.4 inches (10-mm) of clearance on the sides and top of the appliance and at least 2.0 inches (50 mm) of clearance in the rear. The rear vents should be completely clear.

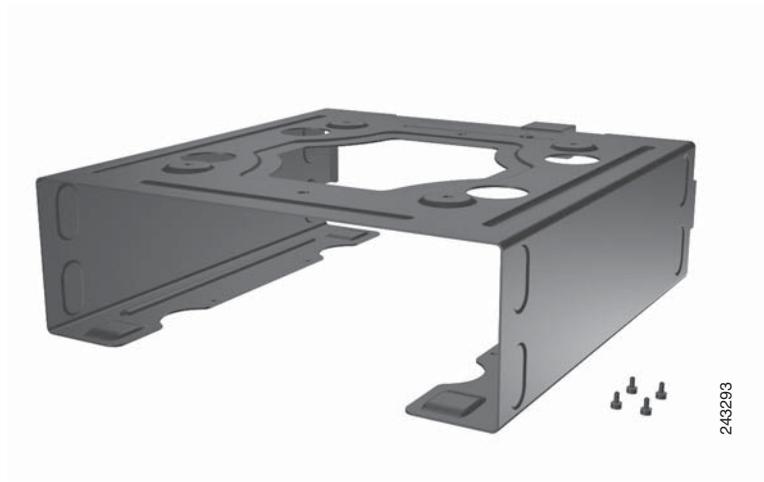
To install the WAVE appliance on a workbench or tabletop, follow these steps:

-
- Step 1** Remove any debris and dust from the tabletop or workbench, as well as from the surrounding area. Also make sure that your path between the WAVE appliance and its new location is unobstructed.
 - Step 2** Place the chassis on the tabletop or workbench.
 - Step 3** Ensure that no exhaust air from other equipment will be drawn into the chassis. Also make sure that there is adequate clearance at the front and rear of the chassis.
-

Installing the WAVE Appliance on a Wall

You can mount the WAVE appliance on a wall or underneath a desk or workbench using the optional mounting sleeve. See [Figure 3-1 on page 3-3](#). Make sure that you consider the location requirements as described in the [“Installing the WAVE Appliance on a Tabletop” section on page 3-2](#).

Figure 3-1 WAVE-274 and WAVE-474 Appliance Mounting Sleeve

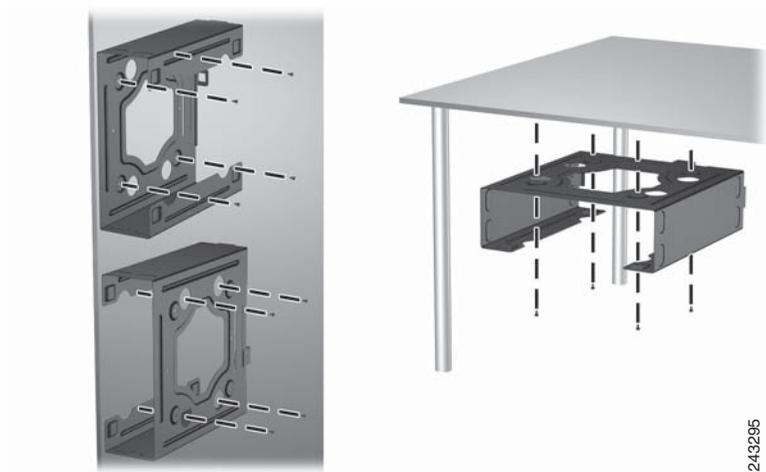


To mount your WAVE appliance using the mounting sleeve, follow these steps.

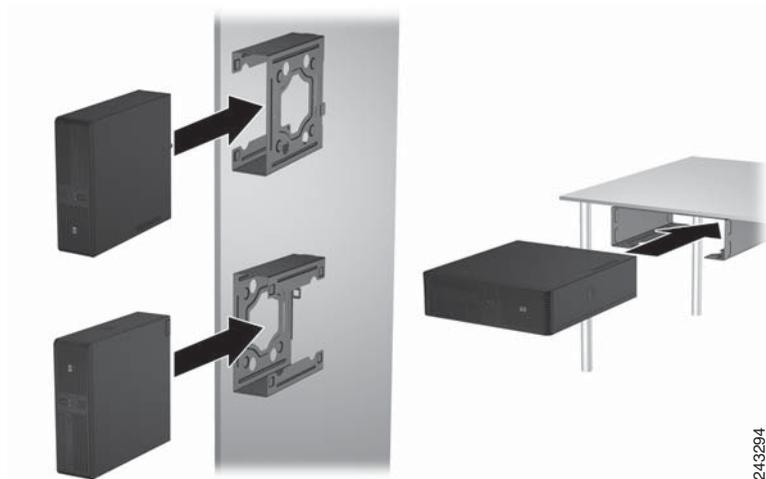
-
- Step 1** Power down the appliance before beginning the installation.
- Step 2** Orient the mounting sleeve as desired and attach it to the mounting surface using the fasteners provided or other appropriate fasteners. See [Figure 3-2 on page 3-4](#).



Caution Mounting surfaces vary widely. We recommend that you use the appropriate screws or other mounting solution for your type of surface. Be sure your mounting solution is properly installed to support the weight.

Figure 3-2 Attaching the Mounting Sleeve

Step 3 Slide the WAVE appliance into the mounting sleeve as shown. See [Figure 3-3 on page 3-4](#).

Figure 3-3 Inserting the WAVE Appliance into the Mounting Sleeve

Installing the WAVE Appliance in an Equipment Rack

Use the optional rackmount shelf to install your WAVE-274 or WAVE-474 in an equipment rack. Make sure that you follow the guidelines described in the following topics:

- [Rack-Mounting Considerations, page 3-5](#)
- [Rack Requirements, page 3-6](#)

Rack-Mounting Considerations

Before installing your WAVE appliance in a rack, review the following guidelines:

- Ensure that the room air temperature is below 95 °F (35 °C).
- Do not block any air vents; usually 6 inches (15 cm) of space provides proper airflow.
- Plan the device installation starting from the bottom of the rack.
- Install the heaviest device in the bottom of the rack.
- Do not extend more than one device out of the rack at the same time.
- Remove the rack doors and side panels to provide easier access during installation.
- Connect the WAVE appliance to a properly grounded outlet.
- Do not overload the power outlet when installing multiple devices in the rack.



Caution

Use safe practices when lifting.



Caution

Do not place any object weighing more than 110 lb (50 kg) on top of rack-mounted devices.



Caution

Install the appliance only in a rack cabinet with perforated doors.

Rack Requirements

Install your WAVE appliance in a rack that meets the following requirements:

- Minimum depth of 2.76 inches (70 mm) between the front mounting flange and inside of the front door.
- Minimum depth of 6.18 inches (157 mm) between the rear mounting flange and inside of the rear door.
- Minimum depth of 28.27 inches (718 mm) and maximum depth of 30 inches (762 mm) between the front and rear mounting flanges to support the use of the cable-management arm.

Racks are marked in vertical increments of 1.75 inches (4.44 cm). Each increment is referred to as a rack unit (RU). A 1-RU device is 1.75 inches (4.44 cm) tall.

Connecting Cables

To connect cables to your WAVE appliance, follow these steps:

-
- Step 1** Power down the appliance before connecting cables to or disconnecting any cables from the appliance.
 - Step 2** See the documentation that comes with your optional equipment for additional cabling instructions. It might be easier for you to route the cables before you install specific optional equipment.
 - Step 3** See the cable identifiers that are printed on the cables that come with the WAVE appliance and options. Use these identifiers to connect the cables to the correct connectors.
-

[Figure 1-2](#) shows the locations of the input and output connectors on your appliance.

Connecting Power and Booting the System

To connect power to your system, follow these steps:

-
- Step 1** Review the information in the [“Safety Guidelines” section on page 2-4](#).
 - Step 2** Plug a power cord into the power cord receptacle on the back of the WAVE appliance.
 - Step 3** Connect the other end of the power cord to a power source at your installation site.
 - Step 4** Power up all externally connected devices.
 - Step 5** Press the power control button on the front of the WAVE appliance.

The system should begin booting. Once the operating system boots, you are ready to initialize the basic software configuration. (See the software configuration guide for details.)



Note While the WAVE appliance is powering up, the green power-on LED on the front of the WAVE appliance is on.

Checking the LEDs

When the WAVE appliance is up and running, observe the front panel LEDs (see [Figure 1-1](#) and [Table 1-1](#)) to verify that your system is operating properly.

To troubleshoot using the LEDs, see [Chapter 5, “Troubleshooting the System Hardware.”](#)

Removing or Replacing a WAVE Appliance

To remove a WAVE appliance from your network, power it down, disconnect the power cords and network cables, and physically remove the chassis from the rack.

The WAVE appliance is in constant communication with the router on your network. When the router notices that the WAVE appliance is no longer responding to it, the router stops sending requests to the WAVE appliance. This action is transparent to users. If other WAVE appliances are attached to the router, the router continues sending requests to the other WAVE appliances.

When you remove a WAVE appliance, the pages that were cached on that device are no longer available to the router or other WAVE appliances. You might see an increase in outgoing web traffic that might have otherwise been fulfilled by the WAVE appliance that you are removing. However, after a time, the router and other WAVE appliances redistribute the load of web traffic.

If you remove the last WAVE appliance from your network, you can also disable WAVE appliance support on the router. However, this action is not necessary because leaving WAVE appliance support enabled when there are no WAVE appliances attached has no effect on the router's performance.

To replace a WAVE appliance, remove it from the network, and then install a new WAVE appliance and configure it using the same configuration parameters (IP address and so forth) that you used for the removed WAVE appliance.



CHAPTER 4

WAVE Inline Network Adapter

This chapter describes the Cisco WAVE inline network adapter and contains the following sections:

- [Inline Network Adapter Description, page 4-1](#)
- [Ports and LED Indicators, page 4-3](#)
- [Inline Network Adapter Cabling Requirements, page 4-4](#)
- [Installation Scenarios and Cabling Examples for Fast Ethernet Connections, page 4-7](#)

For adapter specifications, see [Table A-2 in Appendix A, “Wide Area Virtualization Engine Hardware Specifications”](#).

Inline Network Adapter Description

The WAVE-274 and WAVE-474 appliances include one 2-port Gigabit Ethernet inline network adapter.

The Cisco WAVE inline network adapter provides inline traffic interception capability for your appliance. When you configure the WAVE appliance for inline interception mode, you can set attributes to control which interfaces are to be used over which VLANs. By default, the adapter operates on all inline-capable interfaces and VLANs. You can configure the inline redirection feature using the WAAS CLI or the WAAS Central Manager GUI.

**Note**

Throughout this section, we refer to a WAVE appliance configured for inline interception mode as a *WAVE inline appliance*.

The WAAS software defines two new interface types: A group interface that represents an inline pair grouping and a port interface that represents the individual port. These interfaces are referred to as inlineGroup and inlinePort.

InlineGroup interfaces are numbered using the format slot/group. The slot number is the slot in which the adapter is inserted. The group number is either 0 or 1 (each adapter has 2 group pairs). The group number is displayed on the adapter label.

InlinePort interfaces are numbered slot/group/lan or slot/group/wan. The last attribute is the LAN or WAN designator.

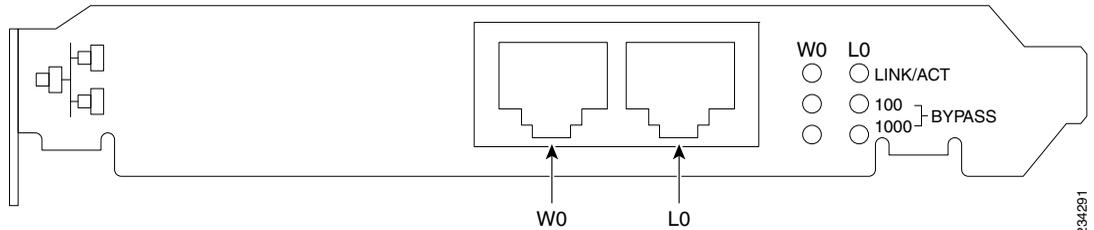
The inline network adapter also includes an onboard programmable watchdog timer (WDT) controller that allows you to set the time to wait after a failure event, such as a power outage or a kernel crash, before the unit begins to operate in mechanical bypass mode. In mechanical bypass mode, the traffic is bridged between the LAN and WAN ports of each group. Mechanical bypass mode prevents the WAVE appliance from becoming a single point of failure and allows traffic to continue to flow between the router and the client while it passes through an unresponsive WAVE appliance without being processed.

For more information about configuring the inline network adapter, see the *Cisco Wide Area Application Services Configuration Guide*.

Ports and LED Indicators

Figure 4-1 shows the 2-port inline network adapter port numbers, interface designations, and LEDs.

Figure 4-1 2-Port Inline Network Adapter Port Numbering and LEDs



W0	Port WAN0; Group 0 WAN interface	L0	Port LAN0; Group 0 LAN interface
-----------	----------------------------------	-----------	----------------------------------

The inline network adapter has three LEDs that correspond to each port (the W0 LEDs correspond to Port W0, and the W1 LEDs correspond to Port W1).

Table 4-1 describes the LEDs.

Table 4-1 Inline Network Adapter LEDs

LEDs	State	Description
Link / Activity	On	The 10/100/1000BASE-T interface is receiving power.
	Blinking	The Ethernet link is transmitting data.
100	On	The speed of the Ethernet connection is 100BASE-TX.
1000	On	The speed of the Ethernet connection is 1000BASE-TX.
Bypass	Both the 100 and 1000 LEDs are on	The corresponding ports are in mechanical bypass mode.

Inline Network Adapter Cabling Requirements

The inline network adapter ships with two types of cables: crossover and straight-through. When you connect the WAVE inline network adapter, the cable that you use depends on the link speed (Gigabit Ethernet or Fast Ethernet) and the types of devices (DCE or DTE) being connected.



Note

You must retain the same link speed from one end of the connection to the other end. Inline adapter interfaces are able to autonegotiate link speeds. If you configure any of your connecting interfaces for Fast Ethernet (whether on a switch or a router), your WAVE inline adapter uses Fast Ethernet. If you configure any of your connecting interfaces for Gigabit Ethernet, your WAVE inline adapter uses Gigabit Ethernet. Speed and duplex settings are port specific so that two inline ports can negotiate different speeds independently.

If you are connecting a WAVE inline appliance between two devices using Gigabit Ethernet, you can use either straight-through cables, crossover cables, or any combination of the two cable types, regardless of the type of device. However, for consistency, we recommend that you use straight-through cables for all Gigabit Ethernet connections.

Table 4-2 shows the cable requirements for WAVE appliance and non-WAVE appliance connections when you are using Gigabit Ethernet end to end.

Table 4-2 *Cable Requirements for WAVE Connections Using Gigabit Ethernet*

Connection	Required Cable
Switch to switch (no WAVE)	Crossover or straight-through
Switch to router (no WAVE)	Crossover or straight-through
Router to router (no WAVE)	Crossover or straight-through
Switch to WAVE and WAVE to Router	Crossover or straight-through
Switch to WAVE and WAVE to Switch	Crossover or straight-through

Table 4-2 *Cable Requirements for WAVE Connections Using Gigabit Ethernet (continued)*

Connection	Required Cable
Router to WAVE and	Crossover or straight-through
WAVE to Router	Crossover or straight-through
WAVE to WAVE	Crossover or straight-through

Some switches support automatic medium-dependent interface crossover (MDIX). You can configure MDIX by using the **mdix auto** global configuration switch command. If your switch supports MDIX, you do not need to follow these cabling rules because MDIX automatically adjusts transmit and receive pairs when an incorrect cable type (crossover or straight-through) is installed on a 10/100 Fast Ethernet port. However, when you configure MDIX, you must also configure the port to use autosense (not manual selection of speed/duplex).



Caution

If you are connecting to Fast Ethernet ports on both the LAN and the WAN sides of the WAVE inline appliance, you must consider the types of devices that are being connected, and you must use the correct cables. You must follow these cabling instructions for the inline network adapter to work properly. (See [Table 4-3](#). For illustrations and examples, see the “[Installation Scenarios and Cabling Examples for Fast Ethernet Connections](#)” section on page 4-7.)

To connect the inline network adapter using the correct cables for Fast Ethernet connections, follow these steps:

Step 1

Determine the type of cable that you would use for a direct connection between your two end devices (without a WAVE inline network appliance connected between them) by using the following standard cabling rules:

- When you are directly connecting two network devices that are similar, such as two switches, use a crossover cable.
- When you are directly connecting two network devices that are different, such as a switch and router, use a straight-through cable.



Note Because the inline network adapter has an internal crossover connection that becomes active when the InlineGroup interface is placed in mechanical bypass mode, you must decide which cable you would use to connect the two network devices directly, and then you must install the other cable type (on one side, usually the WAN side of the inline appliance) instead.

Table 4-3 shows the cable requirements for WAVE and non-WAVE connections when you are using Fast Ethernet end to end.

Table 4-3 *Cable Requirements for WAVE Connections Using Fast Ethernet*

Connection	Required Cable
Switch to switch (no WAVE)	Crossover
Switch to router (no WAVE)	Straight-through
Router to router (no WAVE)	Crossover
Switch to WAVE and WAVE to Router	Straight-through Crossover
Switch to WAVE and WAVE to Switch	Straight-through Straight-through
Router to WAVE and WAVE to Router	Straight-through Straight-through
WAVE to WAVE	Crossover

- Step 2** Connect Fast Ethernet ports on both the LAN and the WAN sides of the WAVE inline appliance by using the following cable types:
- On the LAN side of the connection, use a straight-through cable between the WAVE inline appliance and the network device.
 - On the WAN side of the connection, use the cable that is different from the cable that you would use to connect the two network devices directly (as determined in [Step 1](#)).

For example, if you are connecting a router and a switch (two different devices) through the WAVE inline appliance, use a straight-through cable on the LAN side of the connection and use a crossover cable on the WAN side of the connection. (If you were connecting the two different devices directly, you would use a straight-through cable, so use the crossover cable instead.)

If you are connecting two switches (or two similar devices), use straight-through cables on both the LAN and the WAN sides of the WAVE inline appliance.

[Figure 4-2](#) and [Figure 4-3](#) show which cables to use for the WAVE LAN and WAN connections between Fast Ethernet ports.

Installation Scenarios and Cabling Examples for Fast Ethernet Connections

WAVE appliances can be installed physically between two network devices (such as the branch office router and branch office LAN switch) by connecting the WAVE inline network adapter ports to the network devices using the proper cables.

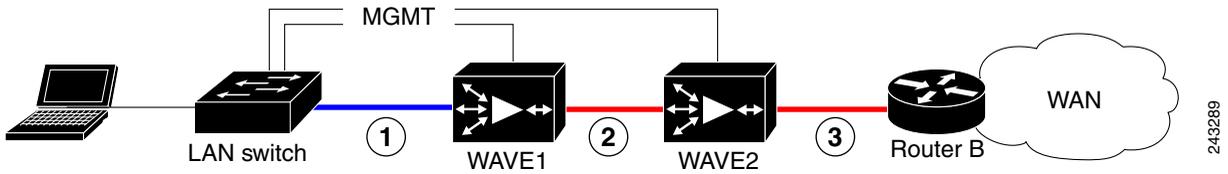
If you are connecting a WAVE inline appliance between two devices using Gigabit Ethernet, you can use either straight-through cables, crossover cables, or any combination of the two cable types, regardless of the type of device. This section shows cabling examples for Fast Ethernet connections only, because Fast Ethernet has specific cabling requirements.

Two WAVE appliances with inline network adapters can be installed back-to-back in a serial fashion between two network devices for failover purposes. In this serial cluster configuration, if one WAVE appliance fails or becomes overloaded, the other WAVE appliance can provide optimization. (See [Figure 4-2](#).)

**Note**

When you connect two WAVE inline appliances to each other serially, always use a crossover cable between the two WAVE appliances. (See [Figure 4-3](#).)

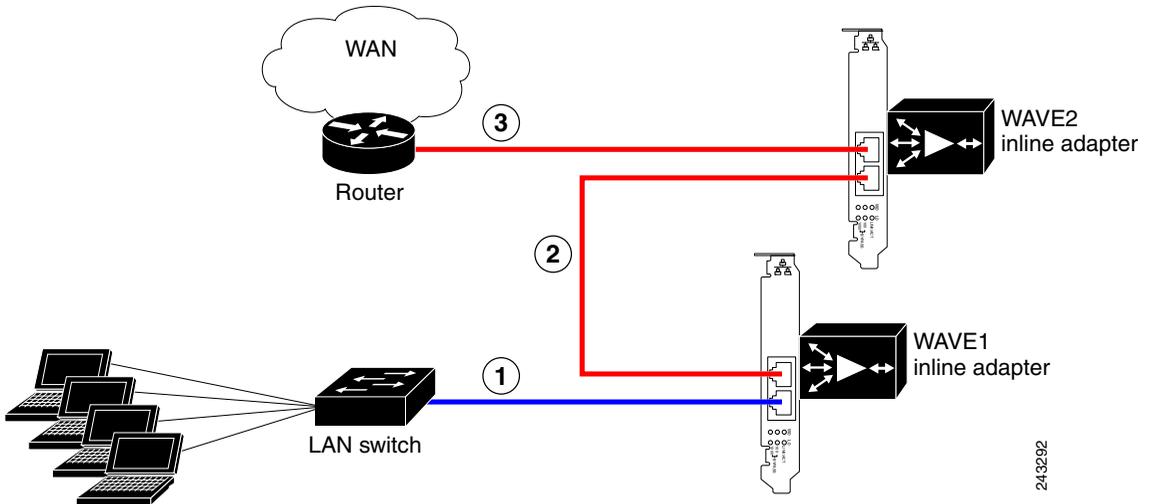
Figure 4-2 Cabling for Serial Cluster Inline WAVEs with a Single WAN Connection



243289

1	Connection: WAVE 1 to LAN switch Fast Ethernet: LAN0 (InlinePort 1/0/lan) Cable type: Straight-through	2	Connection: WAVE 1 to WAVE 2 Fast Ethernet: WAVE1 WAN0 (InlinePort 1/0/wan) to WAVE 2 LAN0 (InlinePort 1/0/lan) Cable type: Crossover
3	Connection: WAVE 2 to WAN router Fast Ethernet: WAVE 2 WAN0 (InlinePort 1/0/wan) Cable type: Crossover		

Figure 4-3 Cabling Between Two Inline WAVEs



1	Connection: WAVE 1 to LAN switch Fast Ethernet: WAVE 1 LAN0 (InlinePort 1/0/lan) Cable type: Straight-through	2	Connection: WAVE 1 to WAVE 2 Fast Ethernet: WAVE 1 WAN0 (InlinePort 1/0/wan) to WAVE 2 LAN0 (InlinePort 1/0/lan) Cable type: Crossover
3	Connection: WAVE 2 to WAN router Fast Ethernet: WAVE 2 WAN0 (InlinePort 1/0/wan) Cable type: Crossover		



CHAPTER 5

Troubleshooting the System Hardware

This chapter provides basic troubleshooting information to help you identify some common problems that might occur with your Wide Area Virtualization Engine (WAVE).

This chapter contains the following sections:

- [Identifying System Problems, page 5-2](#)
- [Checking Connections and Switches, page 5-3](#)
- [Troubleshooting the Ethernet Controller, page 5-4](#)
- [Undetermined Problems, page 5-6](#)
- [Problem-Solving Tips, page 5-7](#)
- [Symptoms and Solutions, page 5-8](#)
- [Power-On Self Test \(POST\), page 5-12](#)

Use the information in this chapter to determine whether a problem originates with the hardware or the software. For further assistance, contact your Cisco customer service representative.



Caution

There are no customer-replaceable components inside your WAVE-274 or WAVE-474 appliance. All faulty components can only be replaced by a qualified service technician. Once you have identified a faulty component, contact the Cisco Technical Assistance Center (TAC).

**Note**

The WAAS software does not support the use of a keyboard or mouse (Personal System/2 [PS/2] or Universal Serial Bus [USB]) for Linux and WAAS software troubleshooting. However, the keyboard and mouse are supported by the BIOS for power-on self-test (POST) and the diagnostic programs that are located in the device ROM.

When console redirection is enabled, all the tests available from a keyboard are accessible through the console connection as well. (Mouse support, however, is not available through the console connection.)

You can run all the diagnostics and tests that are supported by the BIOS, with a few exceptions. Tests for ports (such as the systems-management Ethernet connector and the SAS connector) that are not supported by the WAAS software are invalid.

Identifying System Problems

To identify system problems, follow these steps:

- Step 1** Check the front panel LED indicators. (See [Table 5-10 on page 5-13](#).)
 - Step 2** Power down the device and all external devices.
 - Step 3** Check all cables and power cords. (See the [“Checking Connections and Switches” section on page 5-3](#).)
 - Step 4** Power up all external devices.
 - Step 5** Power up the device.
 - Step 6** Record any POST error messages that are displayed on the screen. If an error is displayed, look up the first error in the [“Power-On Self Test \(POST\)” section on page 5-12](#).
 - Step 7** If you hear one or more beeps, find the beep code in the [“Interpreting POST Diagnostic Front Panel LEDs and Beep Codes” section on page 5-16](#). If necessary, see the [“Undetermined Problems” section on page 5-6](#).
-

Checking Connections and Switches

Improperly set switches and controls and loose or improperly connected cables are the most likely source of problems for the chassis or other external equipment. A quick check of all the switches, controls, and cable connections can easily solve these problems. (See [Figure 1-1](#) for the location of front panel controls and indicators. See [Figure 1-2](#) for the location of back panel connectors on the system.)

To check all the connections and switches, follow these steps:

-
- Step 1** Power down the system. Disconnect all the power cables from their electrical outlets.
- Step 2** If the system is connected to a power strip (or power distribution unit), turn the power strip off and then on again.
- Is the power strip receiving power?
- Yes.* Go to [Step 5](#).
- No.* Go to [Step 3](#).
- Step 3** Plug the power strip into another electrical outlet.
- Is the power strip receiving power?
- Yes.* The original electrical outlet probably does not function. Use a different electrical outlet.
- No.* Go to [Step 4](#).
- Step 4** Plug a system that you know works into the electrical outlet.
- Does the system receive power?
- Yes.* The power strip is probably not functioning properly. Use another power strip.
- No.* Go to [Step 5](#).
- Step 5** Reconnect the system to the electrical outlet or power strip.
- Make sure that all connections fit tightly together.
- Step 6** Power up the system.
- Is the problem resolved?
- Yes.* The connections were loose. You have fixed the problem.

No. Call your customer service representative. (See the [“Obtaining Documentation, Obtaining Support, and Security Guidelines”](#) section on page xix.)

Troubleshooting the Ethernet Controller

This section provides troubleshooting information for problems that might occur with the 10/100/1000-Mbps Ethernet controller.

This section contains the following topics:

- [Network Connection Problems, page 5-4](#)
- [Ethernet Controller Troubleshooting Chart, page 5-5](#)

Network Connection Problems

If the Ethernet controller cannot connect to the network, check the following conditions:

- Make sure that the cable is installed correctly.
The network cable must be securely attached at all connections. If the cable is attached but the problem remains, try a different cable.
If you set the Ethernet controller to operate at either 100 Mbps or 1000 Mbps, you must use Category 5 or higher cabling.
- Determine whether the switch or device to which the WAVE appliance is connected supports autonegotiation. If it does not, try configuring the integrated Ethernet controller manually to match the speed and duplex mode of the switch.
- Check the Ethernet controller LEDs on the device back panel. (See [Figure 1-2](#).)
These LEDs indicate whether a problem exists with the connector, cable, or switch:

- The Ethernet link status LED is on when the Ethernet controller receives a link pulse from the switch. If the LED is off, there might be a defective connector or cable or a problem with the switch.
- The Ethernet activity LED is on when the Ethernet controller sends or receives data over the Ethernet network. If the Ethernet activity LED is off, make sure that the switch and network are operating and that the correct device drivers are installed.
- Make sure that you are using the correct device drivers that are supplied with your device and that the device drivers on the client and the device are using the same protocol.
- Check for operating system-specific causes for the problem.

Ethernet Controller Troubleshooting Chart

Table 5-1 lists solutions to 10/100/1000-Mbps Ethernet controller problems.

Table 5-1 *Ethernet Troubleshooting Chart*

Ethernet Controller Problem	Actions
Ethernet link status LED does not work.	Check the following: <ul style="list-style-type: none"> • Make sure that the switch to which the WAVE appliance is connected is powered on. • Check all connections at the Ethernet controller and the switch. • Use another port on the switch. • If the switch does not support autonegotiation, manually configure the Ethernet controller to match the switch. • If you manually configured duplex mode, make sure that you also manually configure the speed. • Reseat or replace the adapter.
The Ethernet activity LED does not work.	Check the following: <ul style="list-style-type: none"> • The network might be idle. Try sending data from this device.

Table 5-1 Ethernet Troubleshooting Chart (continued)

Ethernet Controller Problem	Actions
Data is incorrect or sporadic.	Check the following: <ul style="list-style-type: none"> • Make sure that you are using Category 5 or higher cabling when operating the device at 100 Mbps or 1000 Mbps. • Make sure that the cables do not run close to noise-inducing sources such as fluorescent lights.
The Ethernet controller stopped working without apparent cause.	Check the following: <ul style="list-style-type: none"> • Try a different connector on the switch. • Reseat or replace the adapter.

Undetermined Problems

Use the information in this section if the diagnostic tests did not identify the failure, the devices list is incorrect, or the system is inoperative.


Note

Damaged data in CMOS can cause undetermined problems.


Note

Damaged data in the BIOS code can cause undetermined problems.

Check the front panel Power LED. If the LED indicates the power supply is working correctly, follow these steps:

-
- Step 1** Power down the device.
- Step 2** Make sure that the device is cabled correctly.
- Step 3** Remove or disconnect the following devices (one at a time) until you find the failure (power up the device and reconfigure it each time):
- Any non-Cisco devices
 - Surge suppressor device (on the device)

- Disk drives
- Memory modules

**Caution**

Any component that is internal to the device must be serviced by trained and qualified personnel. Contact your Cisco customer service representative.

Step 4

Power up the device. If the problem remains, check the following parts in the order listed:

- a. Power backplane
- b. System board

**Note**

If the problem goes away when you remove an adapter from the system, and replacing that adapter does not correct the problem, check the system board.

**Note**

If you suspect a networking problem and all the system tests pass, check if there is a network cabling problem external to the system.

Problem-Solving Tips

Because of the variety of hardware and software combinations that can be encountered, use the following information to assist you in identifying the problems. If possible, have this information available when requesting technical assistance.

- Machine type and model
- Microprocessor or hard disk upgrades
- Failure symptom
 - What, when, where; single or multiple systems?
 - Is the failure repeatable?

- Has this configuration ever worked?
- If it has been working, what changes were made before it failed?
- Is this the original reported failure?
- Hardware configuration
 - Print (print screen) configuration currently in use
 - BIOS level
- WAAS system software type and version level

To eliminate confusion, identical systems are considered identical only if they meet all these conditions:

- Are the exact machine type and models
- Have the same BIOS level
- Have the same adapters or attachments in the same locations
- Have the same address jumpers, terminators, and cabling
- Have the same WAAS software versions
- Have the same configuration options set in the system
- Have the same setup for the operating system control files

Comparing the configuration and software setup in working and nonworking systems might help to resolve the problem.

Symptoms and Solutions

This section lists symptoms, errors, and the possible causes. The most likely cause is listed first. You can use the error symptom tables to find solutions to problems that have definite symptoms.

In [Table 5-2](#) through [Table 5-9](#), the first entry in the “Cause and Action” column is the most likely cause of the symptom.



Caution

Any component that is internal to the device must be serviced by trained and qualified personnel. Contact your Cisco customer service representative.

Table 5-2 *CD-RW/DVD Drive Problems*

Symptom	Cause and Action
CD-RW/DVD drive is not recognized.	<ol style="list-style-type: none"> 1. Verify the following items: <ol style="list-style-type: none"> a. The IDE channel to which the CD-RW/DVD drive is attached (primary) is enabled in the configuration/setup utility program. b. All cables and jumpers are installed correctly. c. The correct device driver is installed for the CD-RW/DVD drive. 2. Check the CD-RW/DVD drive.
The CD-RW/DVD drive is not working correctly.	<ol style="list-style-type: none"> 1. Clean the CD or DVD. 2. Check the CD-RW/DVD drive.
The CD-RW/DVD drive tray is not working.	<ol style="list-style-type: none"> 1. Make sure that the device is turned on. 2. Insert the end of a straightened paper clip into the manual tray-release opening. 3. Check the CD-RW/DVD drive.

Table 5-3 *Hard Disk Drive Problems*

Symptom	Cause and Action
A hard disk drive was not detected while the operating system was being started.	Reseat all hard disk drives and cables. Run the hard disk drive diagnostic tests again.

Table 5-4 *General Problems*

Symptom	Cause and Action
Problems such as a broken cover latch or indicator LEDs not working.	Broken component. Call your customer service representative.

Table 5-5 Intermittent Problems

Symptom	Cause and Action
A problem occurs only occasionally and is difficult to detect.	<ol style="list-style-type: none"> 1. Verify the following items: <ol style="list-style-type: none"> a. All cables are connected securely to the rear of the device. b. When the device is powered on, air is flowing from the rear of the device at the fan grille. If there is no airflow, the fans are not working. This problem causes the device to overheat and shut down. 2. Check the system error log. 3. See the “Undetermined Problems” section on page 5-6.

Table 5-6 Memory Problems

Symptom	Cause and Action
The amount of system memory displayed is less than the amount of physical memory installed.	<ol style="list-style-type: none"> 1. Verify the following items: <ol style="list-style-type: none"> a. No error LEDs are lit on the front panel. b. The memory modules are seated properly. c. All banks of memory on the DIMMs are enabled. The device might have automatically disabled a DIMM bank when it detected a problem. 2. Check the POST error log: <ol style="list-style-type: none"> a. If a DIMM was disabled by a system management interrupt (SMI), the DIMM must be replaced. b. If the DIMM was disabled by the user or by POST, follow these steps: <ul style="list-style-type: none"> – Start the configuration/setup utility program. – Enable the DIMM. – Save the configuration and restart the device. 3. Check the DIMM. 4. Check the system board.

Table 5-7 **Microprocessor Problems**

Symptom	Cause and Action
The device emits a continuous tone during POST, indicating that the microprocessor is not working correctly.	<ol style="list-style-type: none"> 1. Correct any errors that are indicated by the LEDs (see the “Interpreting POST Diagnostic Front Panel LEDs and Beep Codes” section on page 5-16). 2. Check the microprocessor and the VRM.

Table 5-8 **Console Port (Serial Port) Problems**

Symptom	FRU or Action
A serial device does not work. For more information about the serial port, see the “Console Port Serial Connector” section on page 1-6.	<ol style="list-style-type: none"> 1. Verify the following items: <ol style="list-style-type: none"> a. The console device is connected only to the serial port labeled COM1 or CONSOLE a. The device is compatible with the WAVE appliance. b. The device is connected to the correct port (see the “Location of Ports and Connectors” section on page 1-3). 2. Check for a failing serial device. 3. Check the system board.

Table 5-9 **Software Problems**

Symptom	Cause and Action
Suspected software problem.	<ol style="list-style-type: none"> 1. To determine if problems are caused by the software, verify the following items: <ol style="list-style-type: none"> a. Your device has the minimum memory needed to use the software. b. The software is designed to operate on your device. c. The software that you are using works on another device. 2. If you received any error messages when using the application, see the information that comes with the software for a description of the messages and suggested solutions to the problem.

Power-On Self Test (POST)

This section lists the error codes, error messages, and the various indicator light and beep sequences that you may encounter during the Power-On Self-Test (POST) or appliance restart, the probable source of the problem, and steps you can take to resolve the error condition.

The POST Message Disabled mode suppresses most system messages during POST, such as the memory count and non-error text messages. If a POST error occurs, the screen will display the error message. To switch to the POST Messages Enabled mode during POST, press any key (except F10 or F12). The default mode is POST Message Disabled.

This section contains the following topics:

- [POST Overview, page 5-12](#)
- [POST Numeric Codes and Text Messages, page 5-13](#)
- [Interpreting POST Diagnostic Front Panel LEDs and Beep Codes, page 5-16](#)

POST Overview

When you power up the device, it performs a series of tests to check the operation of device components. This series of tests is called the power-on self-test, or POST.

If POST finishes without detecting any problems, no beeps sound, and the first screen of your operating system or application program appears.

If POST detects a problem, more than one beep sounds, and an error message appears on your screen. See the [“POST Numeric Codes and Text Messages” section on page 5-13](#) and [“Interpreting POST Diagnostic Front Panel LEDs and Beep Codes” section on page 5-16](#) for more information.

**Note**

If you have a power-up password or administrator password set, you must enter the password and press **Enter** when prompted, before POST will continue.

**Note**

A single problem might cause several error messages. When this situation occurs, you should correct the cause of the first error message. After you correct the cause of the first error message, the other error messages usually will not occur the next time that you run the test.

POST Numeric Codes and Text Messages

This section covers POST errors that have numeric codes associated with them. The section also includes some text messages that may be encountered during POST.

**Note**

The computer will beep once after a POST text message is displayed on the screen.

Table 5-10 *Diagnostic Front Panel LEDs and Beep Codes*

Control Panel Message	Description
101-Option ROM Checksum Error	System ROM or expansion board option ROM checksum.
103-System Board Failure	DMA or timers.
110-Out of Memory Space for Option ROMs	Recently added PCI expansion card contains an option ROM too large to download during POST.
162-System Options Not Set	Configuration incorrect. RTC (real-time clock) battery may need to be replaced.
163-Time & Date Not Set	Invalid time or date in configuration memory. The RTC (real-time clock) battery may need to be replaced.
163-Time & Date Not Set	CMOS jumper may not be properly installed.
164-Memory Size Error	Memory amount has changed since the last boot (memory added or removed).
164-Memory Size Error	Memory configuration incorrect.

Table 5-10 Diagnostic Front Panel LEDs and Beep Codes (continued)

Control Panel Message	Description
201-Memory Error	RAM failure.
213-Incompatible Memory Module in Memory Socket(s) X, X, ...	A memory module in memory socket identified in the error message is missing critical SPD information or is incompatible with the chip set.
214-DIMM Configuration Warning	Populated DIMM configuration is not optimized.
219-ECC Memory Module Detected ECC Modules not supported on this Platform	Recently added memory module(s) support ECC memory error correction.
301-Keyboard Error	Keyboard failure.
303-Keyboard Controller Error	I/O board keyboard controller.
304-Keyboard or System Unit Error	Keyboard failure.
404-Parallel Port Address Conflict Detected	Both external and internal ports are assigned to parallel port X.
410-Audio Interrupt Conflict	IRQ address conflicts with another device.
411-Network Interface Card Interrupt Conflict	IRQ address conflicts with another device.
501-Display Adapter Failure	Graphics display controller.
510-Flash Screen Image Corrupted	Flash Screen image has errors.
511-CPU, CPUA, or CPUB Fan not Detected	CPU fan is not connected or may have malfunctioned.
512-Chassis, Rear Chassis, or Front Chassis Fan not Detected	Chassis, rear chassis, or front chassis fan is not connected or may have malfunctioned.
514-CPU or Chassis Fan not Detected	CPU or chassis fan is not connected or may have malfunctioned.
610-External Storage Device Failure	External tape drive not connected.
611-Primary Floppy Port Address Assignment Conflict	Configuration error.
660-Display cache is detected unreliable	Integrated graphics controller display cache is not working properly and will be disabled.
912-Computer Cover Has Been Removed Since Last System Startup	Computer cover was removed since last system startup.

Table 5-10 *Diagnostic Front Panel LEDs and Beep Codes (continued)*

Control Panel Message	Description
917-Front Audio Not Connected	Front audio harness has been detached or unseated from motherboard.
918-Front USB Not Connected	Front USB harness has been detached or unseated from motherboard.
922-This system only supports SDVO/ADD2 cards in the x16 slot	The SDVO connector on the system board has the physical appearance of a PCI Express x16 connector; however, the platform does NOT support the use of conventional PCI Express cards or reversed layout ADD2 cards.
1151-Serial Port A Address Conflict Detected	Both external and internal serial ports are assigned to COM1.
1152-Serial Port B Address Conflict Detected	Both external and internal serial ports are assigned to COM2.
1155-Serial Port Address Conflict Detected	Both external and internal serial ports are assigned to the same IRQ.
1201-System Audio Address Conflict Detected	Device IRQ address conflicts with another device.
1202-MIDI Port Address Conflict Detected	Device IRQ address conflicts with another device.
1203-Game Port Address Conflict Detected	Device IRQ address conflicts with another device.
1720-SMART Hard Drive Detects Imminent Failure	Hard drive is about to fail. (Some hard drives have a hard drive firmware patch that will fix an erroneous error message.)
1796-SATA Cabling Error	One or more SATA devices are improperly attached.
1797-SATA Drivelock is not supported in RAID mode.	Drivelock is enabled on one or more SATA hard drives, and they cannot be accessed while the system is configured for RAID mode.
1801-Microcode Patch Error	Processor is not supported by ROM BIOS.
2216-Powered USB cable not attached	Powered USB cable is not properly attached to the USB PlusPower expansion card or to the system board.
Invalid Electronic Serial Number	Electronic serial number has become corrupted.
Memory Parity Error	Parity RAM failure.

Table 5-10 *Diagnostic Front Panel LEDs and Beep Codes (continued)*

Control Panel Message	Description
Network Server Mode Active and No Keyboard Attached	Keyboard failure while Network Server Mode enabled.
Parity Check 2	Parity RAM failure.
System will not boot without fan	CPU fan not installed or disconnected in VSFF chassis.

Interpreting POST Diagnostic Front Panel LEDs and Beep Codes

This section covers the front panel LED codes as well as the beep codes that may occur before or during POST that do not necessarily have an error code or text message associated with them.

[Table 5-11](#) lists the recommended actions in the order in which they should be performed.



Caution

There are no customer-replaceable components inside your WAVE-274 or WAVE-474 appliance. All faulty components can only be replaced by a qualified service technician. Once you have identified a faulty component, contact the Cisco Technical Assistance Center (TAC).

Table 5-11 *POST Diagnostic Front Panel LEDs and Beep Codes*

Activity	Beeps	Possible Cause	Recommended Action
Green Power LED On.	None	Computer on.	None
Green Power LED flashes every two seconds.	None	Computer in Suspend to RAM mode (some models only) or normal Suspend mode.	None required. Press any key or move the mouse to wake the computer.

Table 5-11 POST Diagnostic Front Panel LEDs and Beep Codes (continued)

Activity	Beeps	Possible Cause	Recommended Action
Red Power LED flashes two times, once every second, followed by a 2-second pause. Beeps stop after fifth iteration but LEDs continue until problem is solved.	2	Processor thermal protection activated: A fan may be blocked or not turning or the heatsink/fan assembly is not properly attached to the processor.	<ol style="list-style-type: none"> 1. Ensure that the computer air vents are not blocked and the processor cooling fan is running. 2. Open hood, press power button, and see if the processor fan spins. If the processor fan is not spinning, make sure that the fan's cable is plugged onto the system board header. 3. If the fan is plugged in, but it is not spinning, the fan assembly is faulty. 4. Contact Cisco TAC.
Red Power LED flashes three times, once every second, followed by a 2-second pause. Beeps stop after fifth iteration but LEDs continue until problem is solved.	3	Processor not installed (not an indicator of bad processor).	<ol style="list-style-type: none"> 1. Check to see that the processor is present. 2. Reseat the processor. 3. Contact Cisco TAC.

Table 5-11 POST Diagnostic Front Panel LEDs and Beep Codes (continued)

Activity	Beeps	Possible Cause	Recommended Action
Red Power LED flashes four times, once every second, followed by a 2-second pause. Beeps stop after fifth iteration but LEDs continue until problem is solved.	4	Power failure (power supply is overloaded).	<ol style="list-style-type: none"> 1. Open the hood and ensure the 4 or 6-wire power supply cable is seated into the connector on the system board. 2. Check if a device is causing the problem by removing all attached devices such as hard drives, optical drives, and expansion cards. Power on the system. If the system enters the POST, then power off and replace one device at a time and repeat this procedure until a failure occurs. Replace the device that is causing the failure. Continue adding devices one at a time to ensure that all the devices are functioning properly. 3. Contact Cisco TAC.
Red Power LED flashes five times, once every second, followed by a 2-second pause. Beeps stop after fifth iteration but LEDs continue until problem is solved.	5	Pre-video memory error. CAUTION: To avoid damage to the DIMMs or the system board, you must unplug the computer power cord before attempting to reseat, install, or remove a DIMM module.	<ol style="list-style-type: none"> 1. Reseat DIMMs. 2. Contact Cisco TAC.
Red Power LED flashes six times, once every second, followed by a 2-second pause. Beeps stop after fifth iteration but LEDs continue until problem is solved.	6	Pre-video graphics error.	Contact Cisco TAC.

Table 5-11 *POST Diagnostic Front Panel LEDs and Beep Codes (continued)*

Activity	Beeps	Possible Cause	Recommended Action
Red Power LED flashes seven times, once every second, followed by a 2-second pause. Beeps stop after fifth iteration but LEDs continue until problem is solved.	7	System board failure (ROM detected failure prior to video).	Contact Cisco TAC.
Red Power LED flashes eight times, once every second, followed by a 2-second pause. Beeps stop after fifth iteration but LEDs continue until problem is solved.	8	Invalid ROM based on bad checksum.	Contact Cisco TAC.
Red Power LED flashes nine times, once every second, followed by a 2-second pause. Beeps stop after fifth iteration but LEDs continue until problem is solved.	9	System powers on but is unable to boot.	Contact Cisco TAC.

Table 5-11 *POST Diagnostic Front Panel LEDs and Beep Codes (continued)*

Activity	Beeps	Possible Cause	Recommended Action
Red Power LED flashes ten times, once every second, followed by a 2-second pause. Beeps stop after fifth iteration but LEDs continue until problem is solved.	10	Bad option card.	<ol style="list-style-type: none"> 1. Check installed cards by removing the card (one at a time if multiple cards), and then power on the system to see if fault goes away. 2. Once a bad card is identified, remove and replace the bad card. 3. Contact Cisco TAC.
System does not power on and LEDs are not flashing.	None	System unable to power on.	<p>Press and hold the power button for less than 4 seconds. If the hard drive LED turns green, the power button is working correctly.</p> <p>If the hard drive LED does not turn on green then try the following:</p> <ol style="list-style-type: none"> 1. Check that the unit is plugged into a working AC outlet. 2. Check that the power button harness is connected to the system board. 3. Check that both power supply cables are properly connected to the system board. 4. Contact Cisco TAC.



APPENDIX **A**

Wide Area Virtualization Engine Hardware Specifications

This appendix provides hardware specifications for the Wide Area Virtualization Engine (WAVE) 274 and 474 appliances. It contains the following sections:

- [Appliance Specifications, page A-1](#)
- [Inline Adapter Specifications, page A-4](#)

Appliance Specifications

[Table A-1](#) provides a summary of the features and specifications of the WAVE-274 and WAVE-474.

Table A-1 **WAVE-274 and WAVE-474 Features and Specifications**

Specification	Description
Microprocessor	<ul style="list-style-type: none">• Intel Core2 Duo E6400 Processor, 2.13-GHz• 2 MB Level 2 cache• 1066-MHz front-side bus (FSB)
Memory	<ul style="list-style-type: none">• 3 GB DDR2 Synch DRAM PC2-5300 (667-MHz) Non ECC (2 × 1 GB and 2 × 512 MB)
Drives standard	<ul style="list-style-type: none">• DVD-ROM/CD-RW combination drive• 250 GB SATA 3.0 Gb/s, 7200 rpm

Table A-1 WAVE-274 and WAVE-474 Features and Specifications (continued)

Specification	Description
Size	<ul style="list-style-type: none"> • Height: 3.94 in. (10.0 cm) • Depth: 15.0 in. (38.0 cm) • Width: 13.4 in. (34.0 mm)
Weight	18.6 lb (8.4 kg) typical
Ports	<ul style="list-style-type: none"> • USB: 6 USB 2.0 (2 front, 4 rear) • Console: 2 RS232 serial ports individually configurable to power 5 V and 12 V. COM1 can be configured for 5 V, 9 V, and 12 V • Parallel: 1 • PS/2: 2 • Video: 1 • Audio: 2, line in and line out • NIC: RJ-45 • Inline Network Adapter: 2 (see Inline Adapter Specifications, page A-4)
Power	<ul style="list-style-type: none"> • Operating Voltage Range: 90 to 264 VAC • Rated Voltage Range: 100 to 240 VAC • Rated Line Frequency: 50/60 Hz • Operating Line Frequency Range: 47 – 63 Hz • Rated Input Current: 5 A @ 90 VAC (3.5 A at 90 VAC with 80% efficient power supply) • Heat Dissipation: typical 273 btu/hr (69 kg-cal/hr), maximum 1024 btu/hr (258 kg-cal/hr) • Power Supply Fan: 80 mm variable speed fan

Table A-1 WAVE-274 and WAVE-474 Features and Specifications (continued)

Specification	Description
Environment	<ul style="list-style-type: none"> • Air temperature: <ul style="list-style-type: none"> – Device on: 50 to 104°F (10 to 40°C); altitude: 0 to 2000 m (6500 ft) – Device off: –22 to 140°F (–30 to 60°C); maximum altitude: 9144 m (30000 ft) • Humidity <ul style="list-style-type: none"> – Device on: 20 to 80% (noncondensing at ambient) – Device off: 5 to 90% (noncondensing at ambient)
¹ Acoustical noise emissions	<ul style="list-style-type: none"> • Declared sound power, idle: 3.8 bel² • Declared sound power, operating: 4.9 bel
³ Heat Output	<ul style="list-style-type: none"> • Minimum configuration: 1230 Btu⁴ (360 watts) • Maximum configuration: 3390 Btu (835 watts)

1. These levels were measured in controlled acoustical environments according to the procedures specified by the American National Standards Institute (ANSI) S12.10 and ISO 7779 and are reported in accordance with ISO 9296. Actual sound-pressure levels in a given location might exceed the average values stated because of room reflections and other nearby noise sources. The declared sound-power levels indicate an upper limit, below which a large number of computers will operate.
2. In acoustics, the logarithm of the ratio of a quantity to a reference quantity of the same kind is called a level. The base of the logarithm (always ten, unless otherwise specified), the reference quantity, and the kind of level shall be specified. bel is a unit of level when the base of the logarithm is ten, and the quantities concerned are proportional to power.
3. Power consumption and heat output vary depending on the number and type of optional features installed and the power-management optional features in use.
4. BTU = British Thermal Unit.

Inline Adapter Specifications

Table A-2 describes the inline network adapter technical and general specifications.

Table A-2 *Inline Network Adapter Specifications*

Specification	Description
Copper Gigabit Ethernet Specifications	
IEEE standard	Gigabit Ethernet, 1000BASE-T Fast Ethernet, 100BASE-T Ethernet, 10BASE-T
Full duplex and half duplex	Supports both half-duplex and full-duplex operation in all operating speeds
Autonegotiation	Autonegotiates between full-duplex and half-duplex operations and between 1000-Mbps, 100-Mbps, and 10-Mbps speeds
Data transfer rate	1000-Mbps, 100-Mbps, and 10-Mbps speeds per port in half-duplex mode 2000-Mbps, 200-Mbps, and 20-Mbps speeds per port in full-duplex mode
Ports	2 × RJ-45 socket connectors
General Technical Specifications	
Interface standard	PCI-Express Base Specification Revision 1.0
Size	PCI Short add in card: 6.6 × 4.4 in. (167.6 × 111.2 mm)
PCI Express card type	×4
PCI Express connector	Gold Finger: ×4
PCI voltage	+3.3 V ±9% +12 V ±8%
Weight	6.4 oz (180.0 g)
Operating humidity	0 to 90%, noncondensing
Operating temperature	32 to 122 °F (0 to 50 °C)
Storage temperature	-4 to 149 °F (-20 to 65 °C)



APPENDIX **B**

Maintaining the Wide Area Virtualization Engine

Proper use of preventive maintenance procedures can keep the Wide Area Virtualization Engine (WAVE) in good operating condition and minimize the need for costly, time-consuming service procedures. This chapter contains maintenance procedures that you should perform regularly.

This chapter covers the tasks required for maintaining a WAVE appliance or a WAVE farm:

- [Maintaining Your Site Environment, page B-1](#)
- [Using Power Protection Devices, page B-7](#)

Maintaining Your Site Environment

An exhaust fan in the power supply cools the power supply and system by drawing air in through various openings in the system and blowing it out the back. However, the fan also draws dust and other particles into the system, causing contaminant buildup, which results in an increase in the system's internal temperature and interferes with the operation of various system components.

To avoid these conditions, we recommend keeping your work environment clean to reduce the amount of dust and dirt around the system, thereby reducing the amount of contaminants drawn into the system by the power supply fan.

This section discusses various environmental factors that can adversely affect system performance and longevity.

- [Temperature, page B-2](#)
- [Humidity, page B-3](#)
- [Altitude, page B-3](#)
- [Dust and Particles, page B-4](#)
- [Corrosion, page B-4](#)
- [Electrostatic Discharge, page B-4](#)
- [Electromagnetic and Radio Frequency Interference, page B-5](#)
- [Magnetism, page B-5](#)
- [Shock and Vibration, page B-6](#)
- [Power Source Interruptions, page B-6](#)

Temperature

Temperature extremes can cause a variety of problems, including premature aging and failure of chips or mechanical failure of devices. Extreme temperature fluctuations can cause chips to become loose in their sockets and can cause expansion and contraction of disk drive platters, resulting in read or write data errors.

To minimize the negative effects of the temperature on system performance, follow these guidelines:

- Ensure that the system is operated in an environment no colder than 50 °F (10 °C) or hotter than 95 °F (35 °C).
- Ensure that the system has adequate ventilation. Do not place it within a closed-in wall unit or on top of cloth, which can act as insulation. Do not place it where it will receive direct sunlight, particularly in the afternoon. Do not place it next to a heat source of any kind, including heating vents during winter.

Adequate ventilation is particularly important at high altitudes. System performance may not be optimum when the system is operating at high temperatures as well as high altitudes.

- Make sure that all slots and openings on the system remain unobstructed, especially the fan vent on the back of the system.

- Clean the system at regular intervals to avoid any buildup of dust and debris, which can cause a system to overheat.
- If the system has been exposed to abnormally cold temperatures, allow a 2-hour warm-up period to bring it up to a normal operating temperature before turning it on. Failure to do so may cause damage to internal components, particularly the hard disk drive.
- If intermittent system failures are noticed, try reseating any socketed chips, which might have become loose because of temperature fluctuations.

Humidity

High-humidity conditions can cause moisture migration and penetration into the system. This moisture can cause corrosion of internal components and degradation of properties such as electrical resistance and thermal conductivity. Extreme moisture buildup inside the system can result in electrical shorts, which can cause serious damage to the system.

Each system is rated to operate at 20 to 85 percent relative humidity, with a humidity gradation of 10 percent per hour. Buildings in which climate is controlled by air conditioning in the warmer months and by heat during the colder months usually maintain an acceptable level of humidity for system equipment. However, if a system is located in an unusually humid location, a dehumidifier can be used to maintain the humidity within an acceptable range.

Altitude

Operating a system at high altitude (low pressure) reduces the efficiency of forced and convection cooling and can result in electrical problems related to arcing and corona effects. This condition can also cause sealed components with internal pressure, such as electrolytic capacitors, to fail or perform at reduced efficiency.

Each system is designed to operate at a maximum altitude of 6500 feet (2000 meters) and can be stored at a maximum altitude of 30000 feet (9144 meters).

Dust and Particles

A clean operating environment can greatly reduce the negative effects of dust and other particles, which act as insulators and interfere with the operation of a system's mechanical components. In addition to regular cleaning, you should follow these guidelines to deter contamination of the system equipment:

- Do not permit smoking anywhere near the system.
- Do not permit food or drink near the system.
- Use dust covers when the system is not in use.
- Close windows and outside doors to keep out airborne particles.

Corrosion

The oil from a person's fingers or prolonged exposure to high temperature or humidity can corrode the gold-plated edge connectors and pin connectors on various devices in the system. This corrosion on system connectors is a gradual process that can eventually lead to intermittent failures of electrical circuits.

To prevent corrosion, you should avoid touching contacts on boards and cards. Protecting the system from corrosive elements is especially important in moist and salty environments, which tend to promote corrosion. Also, as a further deterrent to corrosion, the system should not be used in extreme temperatures, as explained in the [“Temperature” section on page B-2](#).

Electrostatic Discharge

Electrostatic discharge (ESD) results from the buildup of static electricity on the human body and certain other objects. This static electricity is often produced by simple movements such as walking across a carpet. ESD is a discharge of a static electrical charge that occurs when a person whose body contains such a charge touches a component in the system. This static discharge can cause components, especially chips, to fail. ESD is a problem particularly in dry environments where the relative humidity is below 50 percent.

To reduce the effects of ESD, you should observe the following guidelines:

- Wear a grounding wrist strap. If a grounding wrist strap is unavailable, touch an unpainted metal surface on the chassis periodically to neutralize any static charge.
- Keep components in their antistatic packaging until they are installed.
- Avoid wearing clothing made of wool or synthetic materials.

Electromagnetic and Radio Frequency Interference

Electromagnetic interference (EMI) and radio frequency interference (RFI) from a system can adversely affect devices such as radio and television (TV) receivers operating near the system. Radio frequencies emanating from a system can also interfere with cordless and low-power telephones. Conversely, RFI from high-power telephones can cause spurious characters to appear on the system's monitor screen.

RFI is defined as any EMI with a frequency above 10 kilohertz (kHz). This type of interference can travel from the system to other devices through the power cable and power source or through the air like transmitted radio waves. The Federal Communications Commission (FCC) publishes specific regulations to limit the amount of EMI and RFI emitted by computing equipment. Each system meets these FCC regulations.

To reduce the possibility of EMI and RFI, follow these guidelines:

- Operate the system only with the system cover installed.
- Ensure that the screws on all peripheral cable connectors are securely fastened to their corresponding connectors on the back of the system.
- Always use shielded cables with metal connector shells for attaching peripherals to the system.

Magnetism

Because they store data magnetically, hard disk drives are extremely susceptible to the effects of magnetism. Hard disk drives should never be stored near magnetic sources such as the following:

- Monitors
- TV sets

- Printers
- Telephones with real bells
- Fluorescent lights

Shock and Vibration

Excessive shock can damage the function, external appearance, and physical structure of a system. Each system has been designed to operate properly even after withstanding a minimum of six consecutively executed shock pulses in the positive and negative x, y, and z axes (one pulse on each side of the system). Each shock pulse can measure up to 5 gravities (G) for up to 11 milliseconds (ms). In storage, the system can withstand shock pulses of 20 G for 11 ms.

Excessive vibration can cause the same problems as mentioned earlier for shock, as well as causing components to become loose in their sockets or connectors. Systems can be subject to significant vibration when being transported by a vehicle or when operated in an environment with machinery that causes vibration.

Power Source Interruptions

Systems are especially sensitive to variations in voltage supplied by the AC power source. Overvoltage, undervoltage, and transients (or spikes) can erase data from memory or even cause components to fail. To protect against these types of problems, power cables should always be properly grounded and one or both of the following methods should be used:

- Use one of the power protection devices described in the [“Using Power Protection Devices” section on page B-7](#).
- Place the system on a dedicated power circuit (rather than sharing a circuit with other heavy electrical equipment). In general, do not allow the system to share a circuit with any of the following:
 - Copier machines
 - Air conditioners
 - Vacuum cleaners
 - Space heaters
 - Power tools

- Teletype machines
- Adding machines
- Laser printers
- Facsimile machines
- Any other motorized equipment

Besides these appliances, the greatest threats to a system's supply of power are surges or blackouts caused by electrical storms. Whenever possible, turn off the system and any peripherals and unplug them from their power sources during thunderstorms.

If a blackout occurs—even a temporary one—while the system is turned on, turn off the system immediately and disconnect it from the electrical outlet. Leaving the system on may cause problems when the power is restored; all other appliances left on in the area can create large voltage spikes that can damage the system.

Using Power Protection Devices

A number of devices are available that protect against power problems such as power surges, transients, and power failures. The following subsections describe some of these devices:

- [Surge Protectors, page B-7](#)
- [Line Conditioners, page B-8](#)
- [Uninterruptible Power Supplies, page B-8](#)

Surge Protectors

Surge protectors are available in a variety of types and usually provide a level of protection commensurate with the cost of the device. Surge protectors prevent voltage spikes, such as those caused during an electrical storm, from entering a system through the electrical outlet. Surge protectors, however, do not offer protection against brownouts, which occur when the voltage drops more than 20 percent below the normal AC line voltage level.

Line Conditioners

Line conditioners go beyond the overvoltage protection of surge protectors. Line conditioners keep a system's AC power source voltage at a fairly constant level and therefore can handle brownouts. Because of this added protection, line conditioners cost more than surge protectors—up to several hundred dollars. However, these devices cannot protect against a complete loss of power.

Uninterruptible Power Supplies

Uninterruptible power supply (UPS) systems offer the most complete protection against variations in power because they use battery power to keep the system running when AC power is lost. The battery is charged by the AC power while it is available, so once AC power is lost, the battery can provide power to the system for a limited amount of time—from 15 minutes to an hour or so—depending on the UPS system.

UPS systems range in price from a few hundred dollars to several thousand dollars, with the more expensive units allowing you to run larger systems for a longer period of time when AC power is lost. UPS systems that provide only 5 minutes of battery power let you conduct an orderly shutdown of the system but are not intended to provide continued operation. Surge protectors should be used with all UPS systems, and the UPS system should be Underwriters Laboratories (UL) safety-approved.



INDEX

A

- AC power
 - specifications [A-2](#)
- adapters
 - inline [4-1](#)
- altitude
 - guidelines [B-3](#)

B

- back panel
 - LEDs (figure) [1-4](#)

C

- cables
 - connecting [3-6](#)
- cabling requirements
 - inline network adapter [4-4](#)
 - inline network adapter (examples) [4-7](#)
- cautions
 - description of [xii](#)
- CD/DVD drive

- problems [5-9](#)
- CD/DVD drive activity LED [1-3](#)
- connections
 - cables [3-6](#)
 - power [3-6](#)
 - troubleshooting [5-3](#)
- connectors and ports
 - inline network adapter [4-3](#)
 - locations [1-3](#)
- console port
 - connector pinout [1-6](#)
 - description [1-6](#)
 - problems [5-11](#)
- conventions
 - document [xi](#)
- corrosion
 - preventing damage [B-4](#)

D

- DC power
 - installation precautions [2-6](#)
- document
 - conventions [xi](#)

dust

preventing damage [B-4](#)

E

electromagnetic interference

See EMI

electrostatic discharge

See ESD

EMI

preventing effects of [B-5](#)

environment

maintaining [B-1](#)

ESD

preventing damage [2-7, B-4](#)

Ethernet activity LED [1-5](#)

Ethernet controller

troubleshooting [5-4](#)

troubleshooting (chart) [5-5](#)

Ethernet link LED [1-5](#)

Ethernet port

connector pinouts [1-5](#)

F

front panel

figure [1-2](#)

LEDs [1-3](#)

H

hard disk drive

problems [5-9](#)

hard disk drive activity LED [1-3](#)

hardware

troubleshooting [5-1](#)

humidity

maintenance guidelines [B-3](#)

I

I/O connectors [1-3](#)

inline network adapter

cabling examples [4-7](#)

cabling requirements [4-4](#)

description [4-1](#)

specifications [A-4](#)

installation

tabletop [3-2](#)

warnings [2-1](#)

intermittent problems

troubleshooting [5-10](#)

L

LEDs

back panel (figure) [1-4](#)

checking [3-7](#)

- description [1-3, 1-5](#)
- front panel (table) [1-3](#)
- front view [1-2](#)
- inline network adapter [4-3](#)
- rear view [1-4](#)

- line conditioners
 - using [B-8](#)

M

- magnetism
 - preventing effects of [B-5](#)
- maintenance [B-1 to B-7](#)
- memory
 - problems [5-10](#)
- microprocessor
 - problems [5-11](#)

N

- network
 - connection problems [5-4](#)
 - removing WAVE from [3-7](#)

P

- ports
 - console (serial) [1-6](#)
 - inline network adapter [4-3](#)

- POST
 - description [5-12](#)
 - error codes [5-12](#)
- power
 - connecting to system [3-6](#)
- power on LED [1-3](#)
- power-on self-test
 - See POST
- power source interruptions
 - preventing damage from [B-6](#)
- power supplies
 - using uninterruptible [B-8](#)
- problem solving
 - overview [5-1](#)
 - tips [5-7](#)

R

- rack requirements [3-6](#)
- radio frequency interference
 - See RFI
- removing or replacing WAVE [3-7](#)
- RFI
 - preventing effects of [B-5](#)

S

- safety
 - general precautions [2-4](#)

- warnings [2-1](#)
- serial port
 - connector pinout [1-6](#)
 - description [1-6](#)
 - problems [5-11](#)
- shock
 - preventing damage [B-6](#)
- site environment
 - maintenance factors [B-1](#)
- software problems
 - troubleshooting [5-11](#)
- status LEDs [1-4](#)
- surge protectors
 - using [B-7](#)
- switches
 - troubleshooting [5-3](#)
- symptoms and solutions
 - tables [5-8](#)
- system problems
 - identifying [5-2](#)
- system reliability [2-6](#)

T

- tabletop installation
 - procedure [3-2](#)
- temperature
 - maintenance guidelines [B-2](#)
- troubleshooting

- connections [5-3](#)
- Ethernet controller [5-4](#)
- network connections [5-4](#)
- switches [5-3](#)
- system hardware [5-1](#)
- undetermined problems [5-6](#)

U

- undetermined problems
 - troubleshooting [5-6](#)
- uninterruptible power supplies
 - using [B-8](#)

V

- vibration
 - preventing damage [B-6](#)

W

- warnings
 - installation [2-1](#)
- WAVE
 - maintaining [B-1](#)
 - removing or replacing [3-7](#)
- Wide Area Application Services software. *See* WAAS software