CHAPTER 5

WAVE Interface Modules

This chapter describes Cisco WAVE Interface Modules and contains the following sections:

- Cisco Interface Module Descriptions, page 5-1
- Ports and LED Indicators, page 5-4
- Network Adapter Cabling Requirements, page 5-7
- Installation Scenarios and Cabling Examples for Fast Ethernet Connections, page 5-9

For information on installing an inline adapter in your WAVE-294, see the "Installing a Cisco WAVE Interface Module" section on page 4-1.

For adapter specifications, see Table A-2 in Appendix A.

Cisco Interface Module Descriptions

The WAVE appliance supports one optional 4-port Copper Gigabit Ethernet Interface Module, 8-port Copper Gigabit Ethernet Interface Module, or 4-port Fiber Optic Gigabit Ethernet Interface Module.

This section contains the following topics:

- Gigabit Ethernet Interface Module—Copper
- Gigabit Ethernet Interface Module—Fiber Optic
- Inline Interface

Gigabit Ethernet Interface Module—Copper

The copper Gigabit Ethernet Interface Module is available in 4 or 8 ports. Both models support bypass. (See Figure 5-1 and Figure 5-2.)

Figure 5-1 Gigabit Ethernet Interface Module—4-Port Copper

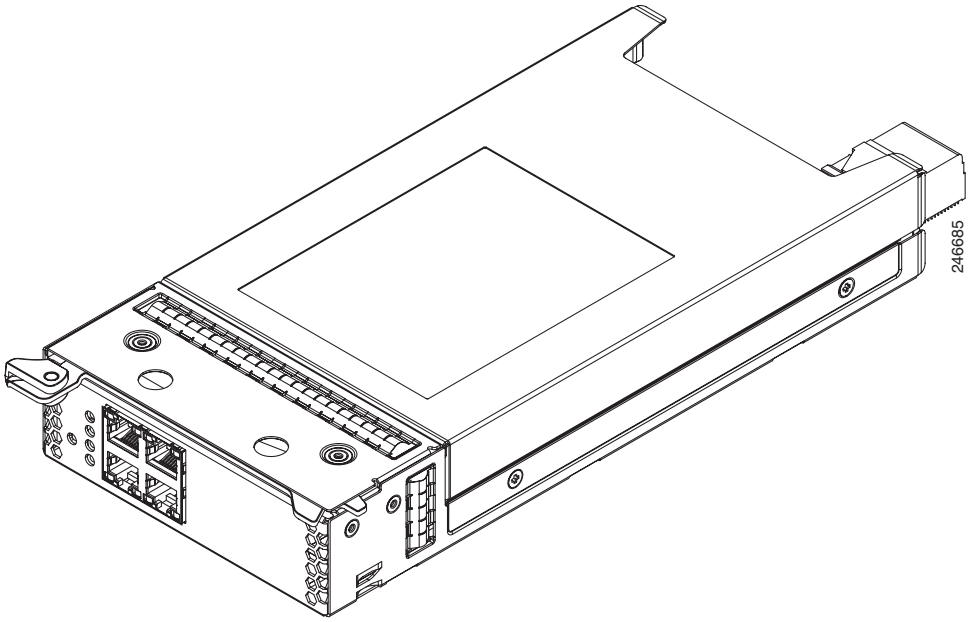
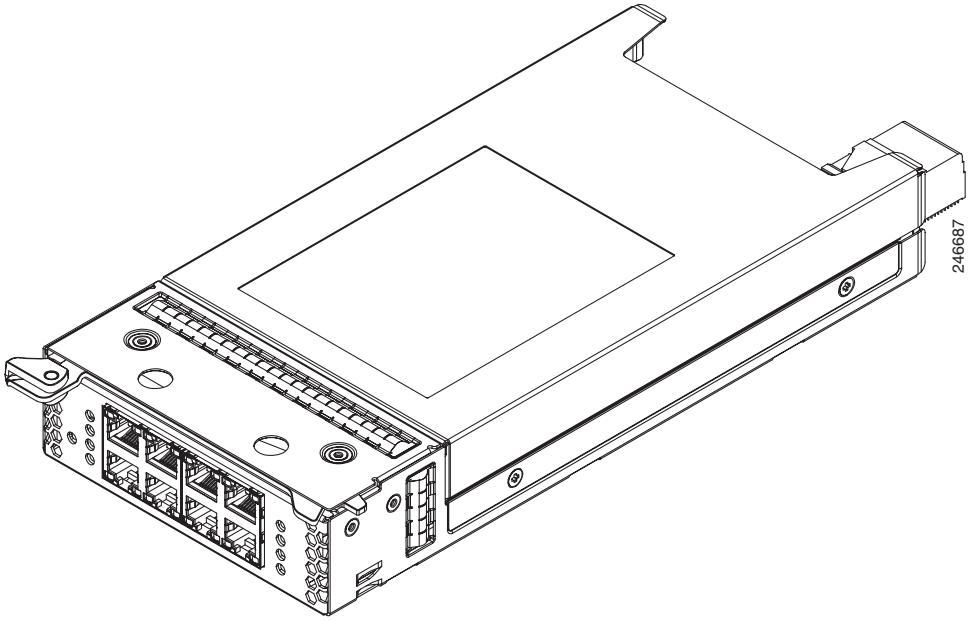


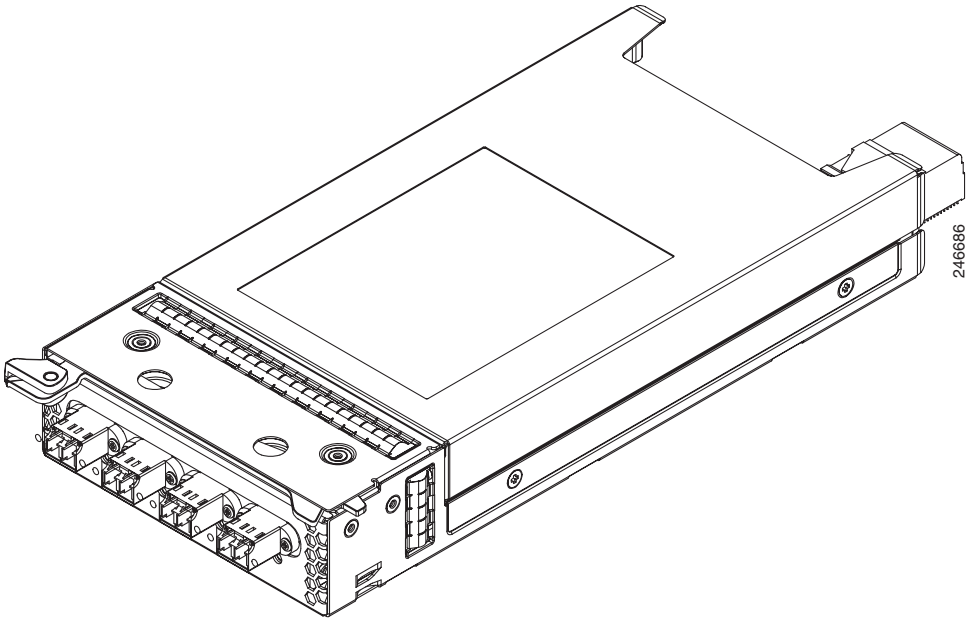
Figure 5-2 Gigabit Ethernet Interface Module—8-Port Copper



Gigabit Ethernet Interface Module—Fiber Optic

The fiber optic Gigabit Ethernet Interface Module is available in 4 ports. This model supports bypass. (See Figure 5-3.)

Figure 5-3 Gigabit Ethernet Interface Module—4-Port Fiber Optic



Inline Interface

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 module 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 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. Since there is only one slot, the slot number is always 1.

The group number starts from 0 and can go up to 4 on 8-port Interface Modules. For 4-port Interface Modules, the groups are numbered 0 and 1. Groups are numbered from left to right.

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

For copper Interface Modules, the top row consists of WAN ports and the bottom row consists of LAN ports. For fiber Interface Modules, the ports are designated as WAN and LAN form left to right. For example, the four ports on the 4-port fiber Interface Module are designated as "W0 L0 W1 L1" in inline mode:

- W0—InlineGroup 1/0/WAN
- L0—InlineGroup 1/0/LAN
- W1—InlineGroup 1/1/WAN
- L1—InlineGroup 1/1/LAN

The inline network adapter also includes an onboard programmable watch dog 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. This can be configured using the **inline failover timeout** global configuration command:

```
(config)# inline failover timeout ?
    <1-1> 1 second
    <25-25> 25 seconds
    <5-5> 5 seconds
```

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 5-4 shows the 4-port Copper Gigabit Ethernet Interface Module port numbers, interface designations, and LEDs. Figure 5-7 shows the same information for the 8-port adapter.

Figure 5-4 4-Port Copper Gigabit Ethernet Interface Module—Port Numbering and LEDs

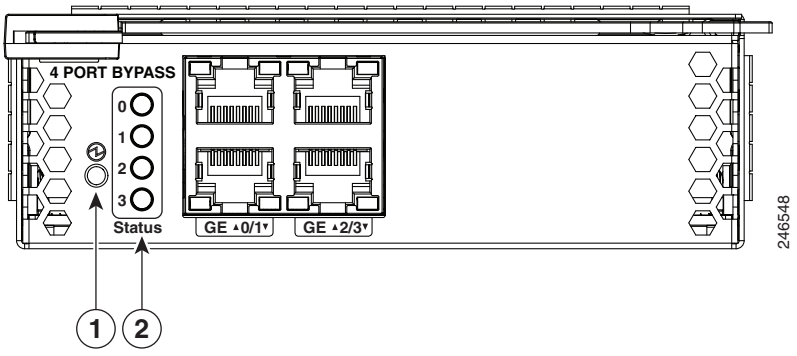
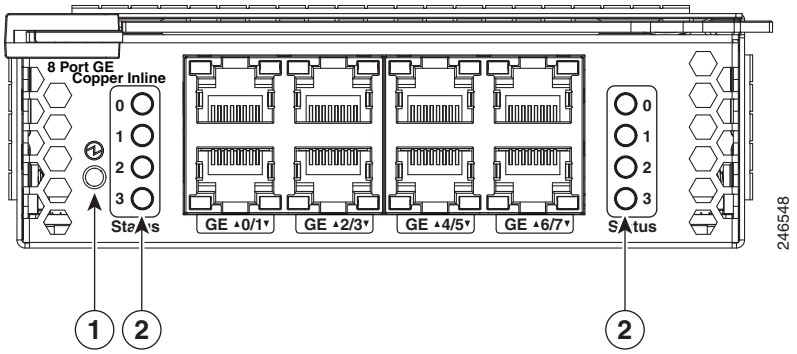


Figure 5-5 8-Port Copper Gigabit Ethernet Interface Module—Port Numbering and LEDs



The Interface Module has an LED that corresponds to each port. Table 5-1 describes the LEDs.

Table 5-1 Copper Interface Module—Power and Status LEDs

LED	Name	Color	State	Description
1	Interface Module power LED	Green	On	Interface Module is receiving power.
		—	Off	Interface Module is not installed or a power supply failure has occurred.
2	Bypass status	Green	Normal	Indicates the inline port pair is in interception mode.
		Amber	Bypass	Indicates the inline port pair is in bypass mode.
		—	Off	No activity exists.

Figure 5-6 shows the Gigabit Ethernet ports and LEDs for the 4-port and 8-port Copper Interface Module.

Figure 5-6 Copper Interface Module—Gigabit Ethernet LEDs

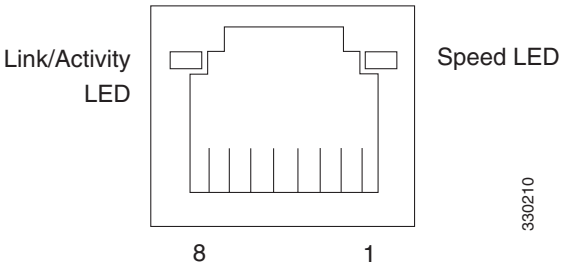


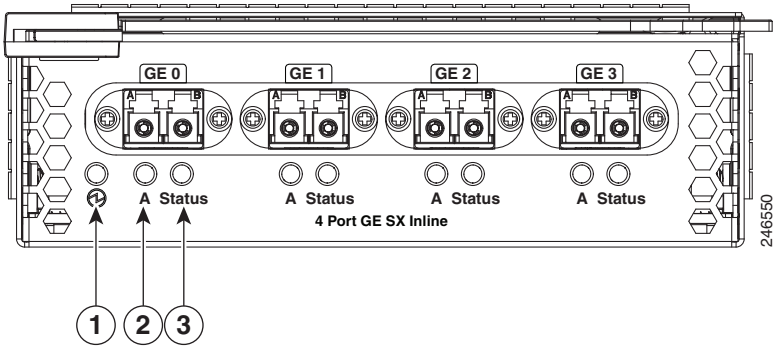
Table 5-2 describes the Gigabit Ethernet port LEDs.

Table 5-2 Copper Interface Module—Gigabit Ethernet LEDs

Name	Color	State	Description
NIC link/activity	Green	On	Link exists.
	Green	Blinking	Activity exists.
	—	Off	No link detected.
NIC speed	—	Off	10Mbps connection.
	Green	On	100Mbps connection.
	Yellow	On	1000Mbps connection.

Figure 5-7 shows the 4-port Fiber Optic Gibabit Ethernet Interface Module port numbers, interface designations, and LEDs.

Figure 5-7 4-Port Fiber Optic Gigabit Ethernet Interface Module—Port Numbering and LEDs



The Interface Module has an LED that corresponds to each port. Table 5-3 describes the LEDs.

Table 5-3 Fiber Optic Interface Module—Power and Status LEDs

LED	Name	Color	State	Description
1	Interface Module power LED	Green	On	Interface Module is receiving power.
		—	Off	Interface Module is not installed or a power supply failure has occurred.
2	Activity	Green	On	Link exists.
		Green	Blinking	Transmitting.
		—	Off	No link detected.
3	Bypass status	Green	Normal	Indicates the inline port pair is in interception mode.
		Amber	Bypass	Indicates the inline port pair is in bypass mode.

Network Adapter Cabling Requirements

Gigabit Ethernet—Copper

The Interface Module 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 5-4 shows the cable requirements for WAVE appliance and non-WAVE appliance connections when you are using Gigabit Ethernet end to end.

Table 5-4 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	Crossover or straight-through
WAVE to Router	Crossover or straight-through
Switch to WAVE and	Crossover or straight-through
WAVE to Switch	Crossover or straight-through
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 5-5. For illustrations and examples, see the "Installation Scenarios and Cabling Examples for Fast Ethernet Connections" section on page 5-9.)

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 5-5 shows the cable requirements for WAVE and non-WAVE connections when you are using Fast Ethernet end to end.

Table 5-5 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	Straight-through
WAVE to Router	Crossover
Switch to WAVE and	Straight-through
WAVE to Switch	Straight-through
Router to WAVE and	Straight-through
WAVE to Router	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 5-8 through Figure 5-10 show which cables to use for the WAVE LAN and WAN connections between Fast Ethernet ports.

Gigabit Ethernet—Fiber Optic

The following three SFP+ pluggable transceiver modules are supported for use with the 2-port Fiber Optic 10 Gigabit Ethernet Interface Module:

- SFP-10G-SR—Short range fiber xcvr
- SFP-H10G-CU3M— Three meter captive copper cable with xcvrs
- SFP-H10G-CU5M— Five meter captive copper cable with xcvrs

Transceivers not supported will be rejected by the software.

For fiber cable length reach and IEEE standards for the supported transceivers, refer to the pluggable 10G optics data sheet on Cisco.com:

http://www.cisco.com/en/US/prod/collateral/modules/ps5455/data_sheet_c78-455693.html

Optical reach is 137 m (449 ft) to any individual port. This allows for a total of 274 m (899 ft) when operating in bypass mode.

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.

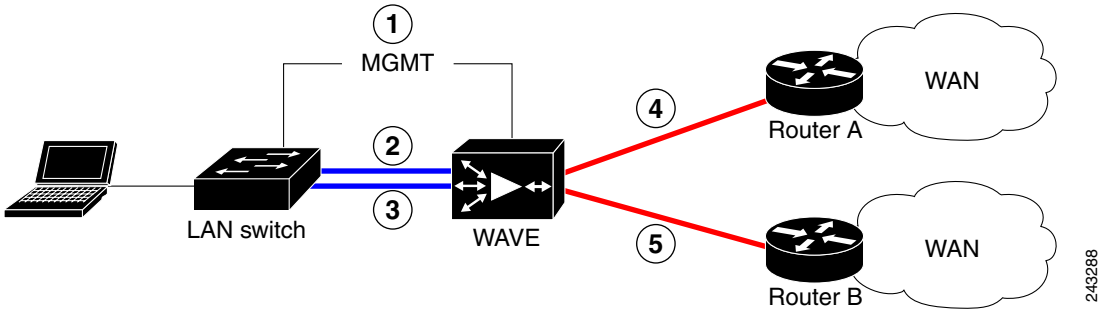
If you are connecting a WAVE inline appliance between two devices using Gigabit Ethernet, you can use either straight-through cables, crossover cables, or any combination of the two cable types, regardless of the type of device. This section shows cabling examples for Fast Ethernet connections only,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

The inline network adapter has four ports that are divided into two inline groups (see the "Ports and LED Indicators" section on page 5-4). The WAVE appliance can be physically placed inline between two distinct network paths, creating redundant WAN links. (See Figure 5-8.)

Two WAVE appliances with inline network adapters can also 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, the other WAVE appliance can provide optimization. (See Figure 5-9.)

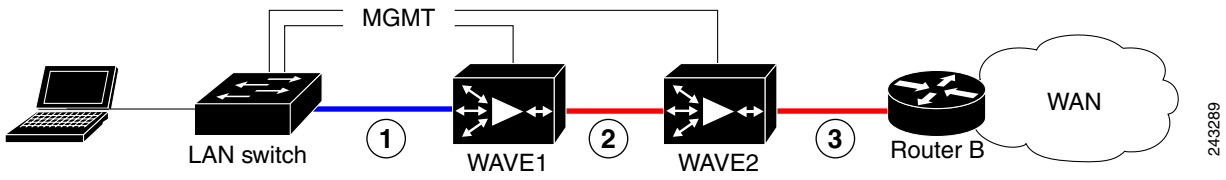
Note When you connect two WAVE inline appliances to each other serially, always use a crossover cable between the two WAVE appliances. (See Figure 5-10.)

Figure 5-8 Cabling for a Single Inline WAVE Appliance with Redundant WAN Connections



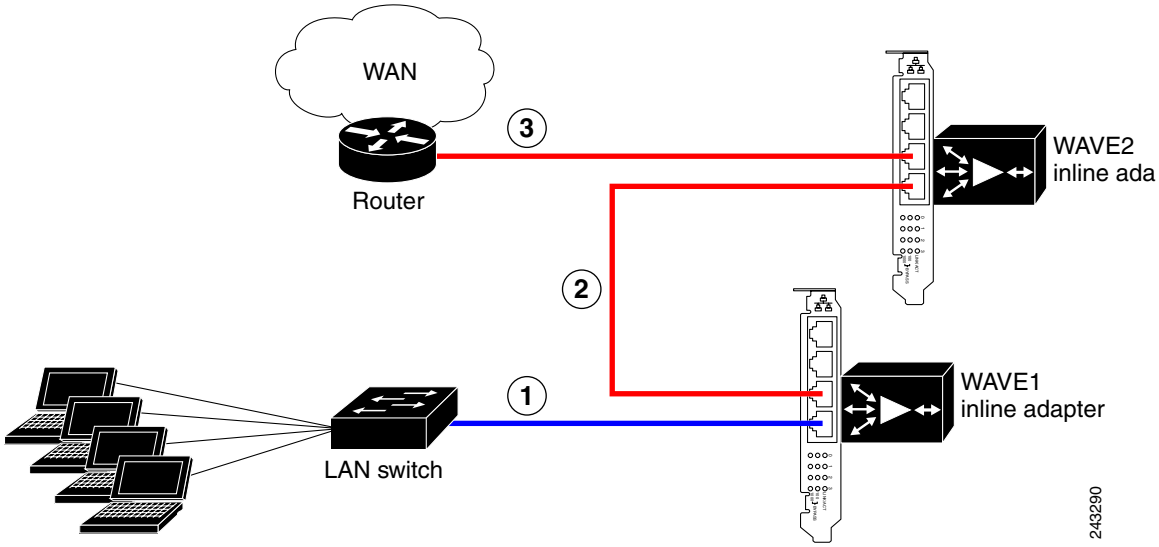
1	Connection: Management Gigabit Ethernet: 1/0 Cable type: Straight-through (recommended)	**2**	Connection: WAVE to LAN switch (using InlineGroup 1/0) Fast Ethernet: LAN0 (InlinePort 1/0/lan) Cable type: Straight-through
3	Connection: WAVE to LAN switch (using InlineGroup 1/1) Fast Ethernet: LAN1 (InlinePort 1/1/lan) Cable type: Straight-through	**4**	Connection: WAVE to WAN router A (using InlineGroup 1/0) Fast Ethernet: WAN0 (InlinePort 1/0/wan) Cable type: Crossover
5	Connection: WAVE to WAN router B (using InlineGroup 1/1) Fast Ethernet: WAN1 (InlinePort 1/1/wan) Cable type: Crossover		

Figure 5-9 Cabling for Serial Cluster Inline WAVEs with a Single WAN Connection



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 5-10 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		