CHAPTER 3

Catalyst 6500 Series Switch SPA Overview

This chapter describes the shared port adapters (SPAs) that are supported on the Catalyst 6500 Series switch and contains the following sections:

SPA Support

Table 3-1 shows the SPAs that are supported on the Catalyst 6500 Series switch.

Table 3-1 SPA Support

SPA	Product Number	Number of Ports	Minimum Cisco IOS Release
2-Port Channelized T3 SPA	SPA-2XCT3/DS0	2	12.2(18)SXE
4-Port Channelized T3 SPA	SPA-4XCT3/DS0	4	12.2(18)SXE
8-Port Channelized T1/E1 SPA	SPA-8XCHT1/E1	8	12.2(18)SXE
2-Port OC-3c/STM-1 ATM SPA	SPA-2XOC3-ATM	2	12.2(18)SXE
4-Port OC-3c/STM-1 ATM SPA	SPA-4XOC3-ATM	4	12.2(18)SXE
1-Port Channelized STM-1/OC-3 SPA	SPA-1XOC12-ATM	1	12.2(18)SXE
1-Port OC-48c/STM-16 ATM SPA	SPA-1XOC48-ATM	1	12.2(18)SXF
2-Port OC-3c/STM-1 POS SPA	SPA-2XOC3-POS	2	12.2(18)SXE
4-Port OC-3c/STM-1 POS SPA	SPA-4XOC3-POS	4	12.2(18)SXE
1-Port OC-12c/STM-4 POS SPA	SPA-1XOC12-POS	1	12.2(18)SXE
1-Port OC-192c/STM-64 POS/RPR SPA	(SPA-OC192RPR-SR, SPA-OC192RPR-IR, SPA-OC192RPR-LR)	1	12.2(18)SXF
1-Port OC-192c/STM-64 POS/RPR XFP SPA	SPA-OC192RPR-LR, SPA-OC192RPR-XFP	1	12.2(18)SXF
2-Port Clear Channel T3/E3 SPA	SPA-2XT3/E3	2	12.2(18)SXE
4-Port Clear Channel T3/E3 SPA	SPA-4XT3/E3	4	12.2(18)SXE
IPSec VPN SPA	SPA-IPSEC-2G	0	12.2(18)SXE2
1-Port 10-Gigabit Ethernet SPA	SPA-1XTENGE-XFP=	1	12.2(18)SXF
2-Port Gigabit Ethernet SPA	SPA-2X1GE=	2	12.2(18)SXF
2-Port Gigabit Ethernet SPA	SPA-2x1GE	2	12.2(18)SXF
5-Port Gigabit Ethernet SPA	SPA-5X1GE=	5	12.2(18)SXF
10-Port Gigabit Ethernet SPA	SPA-10X1GE	10	12.2(18)SXF

Checking For Hardware and Software Compatibility

To check the minimum software requirements of Cisco IOS software with the hardware installed on your router, Cisco maintains the Software Advisor tool on Cisco.com. This tool does not verify whether SIPs or SPAs within a system are compatible, but it does provide the minimum Cisco IOS requirements for individual hardware modules or components.

Note Access to this tool is limited to users with Cisco.com login accounts.

To access Software Advisor, click **Login** at Cisco.com, type "Software Advisor" in the SEARCH box, and click **GO**. Click the link for the Software Advisor tool.

Choose a product family or enter a specific product number to search for the minimum supported software release needed for your hardware.

Bandwidth Oversubscription

Oversubscribing the bandwidth limit recommendations of a router can result in decreased or degraded performance. For this reason, it is important to determine the amount of bandwidth used by the SPAs on the router and verify that the total bandwidth used by all SPAs does not exceed the recommended bandwidth limit of the router. It is also important not to exceed the bandwidth of the SIP. For information on SIP bandwidth, see Chapter 2, "SIP and SSC Support."

Table 3-2 provides information about the bandwidth for each port (per-port bandwidth) on a SPA, as well as the cumulative bandwidth (total bandwidth) for all ports available on the SPA.

Table 3-2 SPA Bandwidth Capacity

SPA	Per-Port Bandwidth	Number of Ports	Total Bandwidth
2-Port Channelized T3 SPA	44.736 Mbps	2	89.47 Mbps
4-Port Channelized T3 SPA	44.736 Mbps	4	178.94 Mbps
8-Port Channelized T1/E1 SPA	1.544 Mbps (T1) 2.048 Mbps (E1)	8	12.35 Mbps (T1) 16.38 Mbps (E1)
2-Port OC-3c/STM-1 ATM SPA	155.52 Mbps	2	311.04 Mbps
4-Port OC-3c/STM-1 ATM SPA	155.52 Mbps	4	622.08 Mbps
1-Port Channelized STM-1/OC-3 SPA	155 Mbps	1	155 Mbps
1-Port OC-48c/STM-16 ATM SPA	2488 Mbps	1	2488 Mbps
2-Port OC-3c/STM-1 POS SPA	155.52 Mbps	2	311.04 Mbps
4-Port OC-3c/STM-1 POS SPA	155.52 Mbps	4	622.08 Mbps
1-Port OC-12c/STM-4 POS SPA	622.08 Mbps	1	622.08 Mbps
1-Port OC-192c/STM-64 POS/RPR SPA	9.95 Gbps	1	9.95 Gbps
1-Port OC-192c/STM-64 POS/RPR XFP SPA	9.95 Gbps	1	9.95 Gbps
1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA	9.95 Gbps	1	9.95 Gbps
2-Port Clear Channel T3/E3 SPA	44.736 Mbps (T3) 34.368 Mbps (E3)	2	89.47 Mbps (T3) 68.74 Mbps (E3)
4-Port Clear Channel T3/E3 SPA	44.736 Mbps (T3) 34.368 Mbps (E3)	4	178.94 Mbps (T3) 137.47 Mbps (E3)
1-Port 10-Gigabit Ethernet SPA	10 Gbps	1	10 Gbps
2-Port Gigabit Ethernet SPA	10 Gbps	2	20 Gbps

Table 3-2 SPA Bandwidth Capacity (continued)

SPA	Per-Port Bandwidth	Number of Ports	Total Bandwidth
2-Port Gigabit Ethernet SPA	1000 Mbps	2	2000 Mbps
5-Port Gigabit Ethernet SPA	1000 Mbps	5	5000 Mbps
10-Port Gigabit Ethernet SPA	1000 Mbps	10	10,000 Mbps

Cisco 7600 SIP-400 Oversubscription Guidelines

As of Cisco IOS Release 12.2(18)SXF, when using the Cisco 7600 SIP-400 with the 2-Port Gigabit Ethernet SPA or the 1-Port OC-48c/STM-16 ATM SPA, consider the following oversubscription guidelines:

- The 7600-SIP-400 only supports installation of one 1-Port OC-48c/STM-16 ATM SPA without any other SPAs installed in the SIP.
- The 7600-SIP-400 supports installation of up to two 2-Port Gigabit Ethernet SPAs without any other SPAs installed in the SIP.
- The 7600-SIP-400 supports installation of any combination of a OC-3, OC-12 POS, CEoP, or ATM SPAs, up to a combined ingress bandwidth of OC-48 rates.
- The 7600-SIP-400 supports installation of any combination of OC-3, OC-12 POS, CEoP, or ATM SPAs up to a combined ingress bandwidth of OC-24 rates, when installed with a single 2-Port Gigabit Ethernet SPA.
- The 7600-SIP-400 supports installation of a single 1-Port 10-Gigabit Ethernet SPA without any other SPAs installed in the 7600-SIP-400.

Note A 1-Port 10-Gigabit Ethernet SPA on a 7600-SIP-400 provides 4 Gbps of bandwidth.

2-Port and 4-Port Channelized T3 SPA Overview

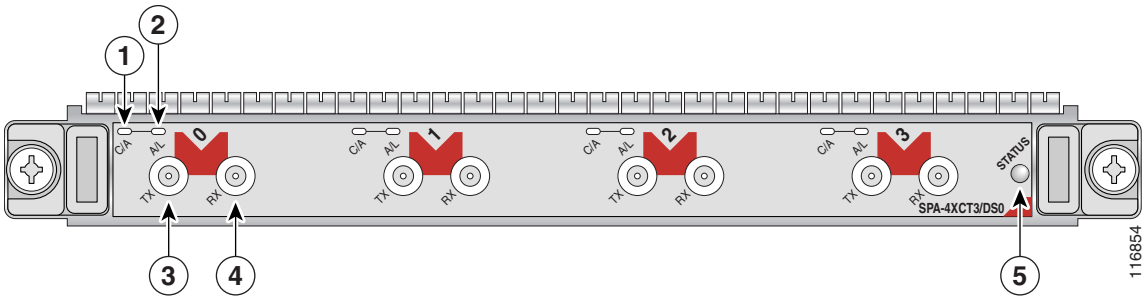
The following sections describe the 2-Port and 4-Port Channelized T3 SPA:

- 2-Port and 4-Port Channelized T3 SPA LEDs, page 3-5
- 2-Port and 4-Port Channelized T3 SPA Interface Specifications, page 3-5
- 2-Port and 4-Port Channelized T3 SPA Cables and Connectors, page 3-6

2-Port and 4-Port Channelized T3 SPA LEDs

The 2-Port and 4-Port Channelized T3 SPA has three types of LEDs. There are two LEDs for each port on the SPA, and one STATUS LED. Figure 3-1 shows an example of these LEDs on a 4-Port Channelized T3 SPA.

Figure 3-1 4-Port Channelized T3 SPA Faceplate



1	C/A (Carrier/Alarm) LED	**4**	RX (Receive) connector
2	A/L (Active Loopback) LED	**5**	STATUS LED
3	TX (Transmit) connector		

Table 3-3 describes the 2-Port and 4-Port Channelized T3 SPA LEDs.

Table 3-3 2-Port and 4-Port Channelized T3 SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and there is a valid T3 signal without any alarms.
	Amber	On	Port is enabled by software, and there is at least one alarm.
A/L	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, loopback is off.
	Amber	On	Port is enabled by software, loopback is on.
STATUS	Off	Off	SPA power is off.
	Amber	On	SPA power is on and good, and SPA is being configured.
	Green	On	SPA is ready and operational.

2-Port and 4-Port Channelized T3 SPA Interface Specifications

The framer processes incoming and outgoing T3 frames (cbit, m13/m23, and unframe). The framer operates at T3 line rates (44.2 Mbps).

Packet data is transported with a user-configurable encapsulation (such as Point-to-Point Protocol [PPP] or High-Level Data Link Control [HDLC]), and is mapped to T3 frames. The encapsulations add transport overhead to the packet of data frames before transporting, and are stripped when a packet is transported to the far end.

The T3 SPA interface is compliant with ANSI and Telco standards. The interface also provides support for Management Information Base (MIB) RFC 2495, RFC 2496, and T1.231.

2-Port and 4-Port Channelized T3 SPA Cables and Connectors

The interface connectors on the 2-Port and 4-Port Channelized T3 SPA are 75-ohm coaxial Siemax types, with one connector and cable for transmit (TX) and one for receive (RX).

The following cables can be used with the 2-Port and 4-Port Channelized T3 SPA. The cables have BNC on one end and the Siemax connectors on the other.

- CAB-T3E3-RF-BNC-M (T3 or E3 Cable, 1.0/2.3 RF to BNC-Male, 10 Feet)
- CAB-T3E3-RF-BNC-F(T3 or E3 Cable, 1.0/2.3 RF to BNC-Female, 10 Feet)
- CAB-T3E3-RF-OPEN (T3 or E3 Cable, 1.0/2.3 RF to BNC-Open end, 10 Feet)

Note The Cisco cable part numbers are 72-4124-01 (with Male BNC end) and 72-4131-01 (with Female BNC end).

Figure 3-1 shows the Siemax connectors on the 2-Port and 4-Port Channelized T3 SPA, and Table 3-4 provides the signal descriptions for these connectors.

Table 3-4 2-Port and 4-Port Channelized T3 SPA Connectors

Connector Label	Meaning
TX	Transmitted signals appear on the center contact, and the outer shield is ground for the 75-ohm RG-59 coaxial cable you attach to the TX Siemax connector.
RX	Received signals appear on the center contact, and the outer shield is ground for the 75-ohm RG-59 coaxial cable you attach to the RX Siemax connector.

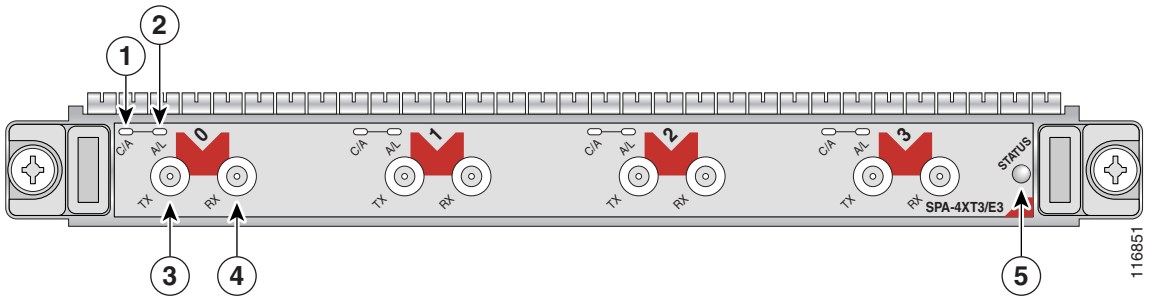
2-Port and 4-Port Clear Channel T3/E3 SPA Overview

The following sections describe the 2-Port and 4-Port Clear Channel T3/E3 SPA:

2-Port and 4-Port Clear Channel T3/E3 SPA LEDs

The 2-Port and 4-Port Clear Channel T3/E3 SPA has three types of LEDs. There are two LEDs for each port on the SPA, and one STATUS LED. Figure 3-2 shows an example of these LEDs on a 4-Port Clear Channel T3/E3 SPA.

Figure 3-2 4-Port Clear Channel T3/E3 SPA Faceplate



1	C/A (Carrier/Alarm) LED	**4**	RX (Receive) connector
2	A/L (Active Loopback) LED	**5**	STATUS LED
3	TX (Transmit) connector		

Table 3-5 describes the 2-Port and 4-Port Clear Channel T3/E3 SPA LEDs.

Table 3-5 2-Port and 4-Port Clear Channel T3/E3 SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and there is a valid E3 or T3 signal without any alarms.
	Amber	On	Port is enabled by software, and there is at least one alarm.
A/L	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, loopback is off.
	Amber	On	Port is enabled by software, loopback is on.
STATUS	Off	Off	SPA power is off.
	Amber	On	SPA power is on and good, and the SPA is being configured.
	Green	On	SPA is ready and operational.

2-Port and 4-Port Clear Channel T3/E3 SPA Interface Specifications

The framer processes incoming and outgoing T3 (cbit, m13/m23, and unframe) and E3 (g751, g832, and unframe) frames. The framer operates at T3/E3 line rates (44.2/34.0 Mbps) depending on which mode it is configured in.

Packet data is transported with a user-configurable encapsulation (such as Point-to-Point Protocol [PPP] or High-Level Data Link Control [HDLC]), and is mapped to T3 and E3 frames. The encapsulations add transport overhead to the packet of data frames before transporting, and are stripped when a packet is transported to the far end.

The T3/E3 SPA interface is compliant with ANSI and Telco standards. The interface also provides support for Management Information Base (MIB) (RFC 2496) and T1.231.

2-Port and 4-Port Clear Channel T3/E3 SPA Cables and Connectors

The interface connectors on the 2-Port and 4-Port Clear Channel T3/E3 SPA are 75-ohm coaxial Siemax types, with one connector and cable for transmit (TX) and one for receive (RX).

The following cables can be used with the 2-Port and 4-Port Clear Channel T3/E3 SPA. The cables have BNC on one end and the Siemax connectors on the other.

- CAB-T3E3-RF-BNC-M (T3 or E3 Cable, 1.0/2.3 RF to BNC-Male, 10 Feet)
- CAB-T3E3-RF-BNC-F(T3 or E3 Cable, 1.0/2.3 RF to BNC-Female, 10 Feet)
- CAB-T3E3-RF-OPEN (T3 or E3 Cable, 1.0/2.3 RF to BNC-Open end, 10 Feet)

Note The Cisco cable part numbers are 72-4124-01 (with male BNC end) and 72-4131-01 (with female BNC end).

Figure 3-2 shows the connectors on the 4-Port Clear Channel T3/E3 SPA, and Table 3-6 describes the signal descriptions for these connectors.

Table 3-6 2-Port and 4-Port Clear Channel T3/E3 SPA Connectors

Connector Label	Meaning
TX	Transmitted signals appear on the center contact, and the outer shield is ground for the 75-ohm RG-59 coaxial cable you attach to the TX BNC connector.
RX	Received signals appear on the center contact, and the outer shield is ground for the 75-ohm RG-59 coaxial cable you attach to the RX BNC connector.

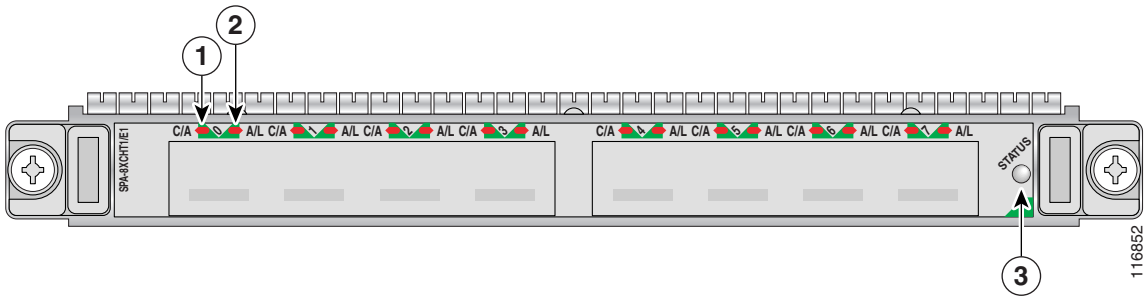
8-Port Channelized T1/E1 SPA Overview

The following sections describe the 8-Port Channelized T1/E1 SPA:

8-Port Channelized T1/E1 SPA LEDs

The 8-Port Channelized T1/E1 SPA has three types of LEDs. There are two LEDs for each port on the SPA, and one STATUS LED as shown in Figure 3-3.

Figure 3-3 8-Port Channelized T1/E1 SPA Faceplate



1	C/A (Carrier/Alarm) LED	**3**	STATUS LED
2	A/L (Active Loopback) LED		

Table 3-7 describes the 8-Port Channelized T1/E1 SPA LEDs.

Table 3-7 8-Port Channelized T1/E1 SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and there is a valid T1 or E1 signal without any alarms.
	Amber	On	Port is enabled by software, and there is at least one alarm.
A/L	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, loopback is off.
	Amber	On	Port is enabled by software, loopback is on.
STATUS	Off	Off	SPA power is off.
	Amber	On	SPA power is on and good, and SPA is being configured.
	Green	On	SPA is ready and operational.

8-Port Channelized T1/E1 SPA Interface Specifications

The E1 interface on the 8-Port Channelized T1/E1 SPA uses RJ-48c receptacles for E1 (120-Ohm) cables with RJ-45 connectors. You can use all ports simultaneously. Each E1 connection supports interfaces that meet G.703 standards. The RJ-45 connection does not require an external transceiver. The E1 ports are E1 interfaces that use 120-ohm unshielded twisted pair (UTP) cables.

8-Port Channelized T1/E1 SPA Cables, Connectors, and Pinouts

Figure 3-4 shows an RJ-45 connector.

Note The terms RJ-45 and RJ-48c are sometimes used interchangeably. The RJ-48c is the jack or receptacle; the RJ-45 is the connector.

Figure 3-4 RJ-45 Connector

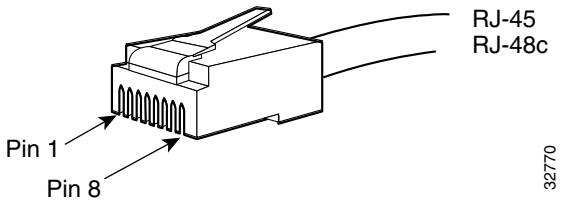


Table 3-8 describes the signals and connector pinouts for RJ-45 cable connectors.

Table 3-8 RJ-45 Connector Pinouts

Pin	Signal	Description
1	RX–	Receive ring –
2	RX+	Receive tip +
3	NC	No connection
4	TX–	Transmit ring –
5	TX+	Transmit tip +
6	NC	No connection
7	NC	No connection
8	NC	No connection

1-Port Channelized STM-1/OC-3 SPA Overview

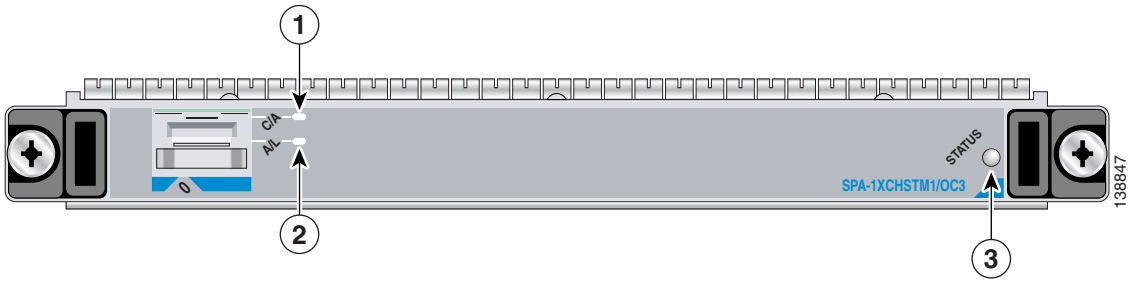
The following sections describe the 1-Port Channelized STM-1/OC-3 SPA:

- 1-Port Channelized STM-1/OC-3 SPA LEDs, page 3-10
- 1-Port Channelized STM-1/OC-3 SPA Interface Specifications, page 3-11
- 1-Port Channelized STM-1/OC-3 SPA Cables and Connectors, page 3-12

1-Port Channelized STM-1/OC-3 SPA LEDs

The 1-Port Channelized STM-1/OC-3 SPA has two types of LEDs: an A/L LED for each port and a STATUS LED, as shown in Figure 3-5.

Figure 3-5 1-Port Channelized STM-1/OC-3 SPA Faceplate



1	C/A (Carrier/Alarm) LED	**3**	STATUS LED
2	A/L (Active Loopback) LED		

Table 3-9 describes the 1-Port Channelized STM-1/OC-3 SPA LEDs.

Table 3-9 1-Port Channelized STM-1/OC-3 SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and there is a valid T3 signal without any alarms.
	Amber	On	Port is enabled by software, and there is at least one alarm.
A/L	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, loopback is off.
	Amber	On	Port is enabled by software, loopback is on.
STATUS	Off	Off	SPA power is off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and good, and SPA is being configured.

1-Port Channelized STM-1/OC-3 SPA Interface Specifications

The framer processes incoming and outgoing SONET or SDH frames. The framer operates at OC-3/STM-1 line rates (155.52 Mbps).

Packet data is transported with a user-configured encapsulation (such as Point-to-Point Protocol [PPP]) and is mapped into the STS-3/STM-1 frame.

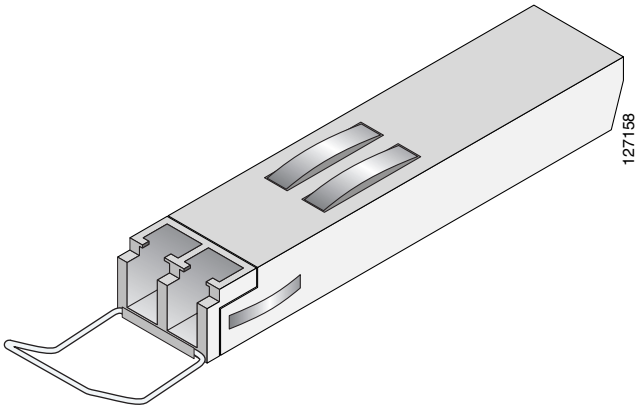
The 1-Port Channelized STM-1/OC-3 SPA interface is compliant with RFC 1619, *PPP over SONET/SDH*, and RFC 1662, *PPP in HDLC-like Framing*. The 1-Port Channelized STM-1/OC-3 SPA also provides support for SNMP v1 agent (RFC 1155–1157), and Management Information Base (MIB) II (RFC 1213).

Note The 1-Port Channelized STM-1/OC-3 SPA supports Frame Relay Fragmentation (FRF.12) and Multilink Fame Relay (MFR) features for Cisco IOS XR Software Release 3.6.0 and later releases.

1-Port Channelized STM-1/OC-3 SPA Cables and Connectors

The 1-Port Channelized STM-1/OC-3 SPA uses a small form-factor pluggable (SFP) optical transceiver module installed in each port for SONET and SDH single-mode and multimode optical fiber connection (see Figure 3-6).

Figure 3-6 SFP Optics Module



The SFP optical transceiver modules used with the 1-Port Channelized STM-1/OC-3 SPA provide the following optical fiber options:

- Multimode—155-Mbps, OC-3/STM-1 optical fiber (SONET STS-3 or SDH STM-1)

  Use a multimode optical fiber that has a core/cladding diameter of 62.5/125 microns.

- Single-mode—155-Mbps, OC-3/STM-1 optical fiber (SONET STS-3 or SDH STM-1)

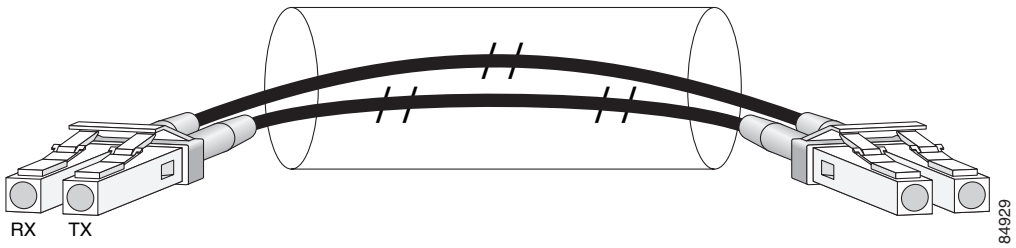
  Use a single-mode optical fiber that has a modal-field diameter of 8.7 ±0.5 microns. (Nominal diameter is approximately 10/125 microns.)

For single-mode and multimode optical fiber connections, you can use either a duplex LC-type cable (see Figure 3-7) or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

Use single-mode (for intermediate- or long-reach configurations) or multimode optical fiber cable to connect your router to a network or to connect two 1-Port Channelized STM-1/OC-3 SPA-equipped routers back to back.

Long-range SFP optical transceiver modules (for long-reach configurations) cannot be connected back-to-back without using an attenuator between the two of them.

Figure 3-7 LC Type Cables



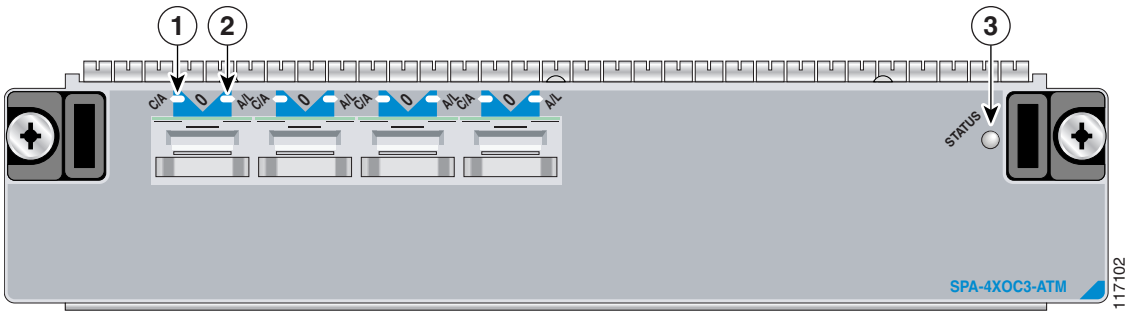
2-Port and 4-Port OC-3c/STM-1 ATM SPA Overview

The following sections describe the 2-Port and 4-Port OC-3c/STM-1 ATM SPA:

2-Port and 4-Port OC-3c/STM-1 ATM SPA LEDs

The 2-Port and 4-Port OC-3c/STM-1 ATM SPA has three types of LEDs. There are two LEDs for each port on the SPA, and one STATUS LED. Figure 3-8 shows an example of these LEDs on a 4-Port OC-3c/STM-1 ATM SPA.

Figure 3-8 4-Port OC-3c/STM-1 ATM SPA Faceplate



1	C/A (Carrier/Alarm) LED	**3**	STATUS LED
2	A/L (Active Loopback) LED		

Table 3-10 describes the 2-Port and 4-Port OC-3c/STM-1 ATM SPA LEDs.

Table 3-10 2-Port and 4-Port OC-3c/STM-1 ATM SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and there is a valid SONET signal without any alarms.
	Amber	On	Port is enabled by software, and there is at least one alarm.
A/L	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, loopback is off.
	Amber	On	Port is enabled by software, loopback is on.
STATUS	Off	Off	SPA power is off.
	Amber	On	SPA power is on and good, and SPA is being configured.
	Green	On	SPA is ready and operational.

2-Port and 4-Port OC-3c/STM-1 ATM SPA Interface Specifications

The physical layer interface for the 2-Port and 4-Port OC-3c/STM-1 ATM SPA is Optical Carrier-3 (OC-3), and the data link layer is designed to comply with ATM specifications. The 2-Port and 4-Port OC-3c/STM-1 ATM SPA provides up to four 155-Mbps OC-3 network interfaces for all supported platforms.

Each SPA port accepts an SFP module with a duplex LC-type receptacle that allows connection to single-mode or multimode optical fiber.

2-Port and 4-Port OC-3c/STM-1 ATM SPA Cables and Connectors

The 2-Port and 4-Port OC-3c/STM-1 ATM SPAs provide the following optical fiber options:

- Multimode—155-Mbps, OC-3 optical fiber (SONET STS-3c or SDH STM-1)

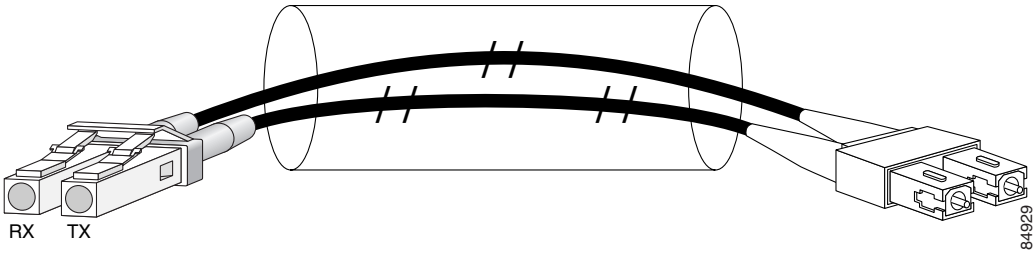
  Use a multimode optical fiber that has a core/cladding diameter of 62.5/125 microns.

- Single-mode—155-Mbps, OC-3 optical fiber (SONET STS-3c or SDH STM-1)

  Use a single-mode optical fiber that has a modal-field diameter of 8.7 ±0.5 microns. (Nominal diameter is approximately 10/125 microns.)

For single-mode and multimode optical fiber connections, you can use either a duplex LC-type cable (see Figure 3-9) or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

Figure 3-9 Duplex Patch Cable with LC-Type Connectors



Use single-mode (for intermediate- or long-reach configurations) or multimode optical fiber cable to connect your router to a network or to connect two OC-3-equipped routers back-to-back.

Long-range SFP optics modules (for long-reach configurations) cannot be connected back-to-back without using an attenuator between the two of them.

2-Port and 4-Port OC-3c/STM-1 POS SPA Overview

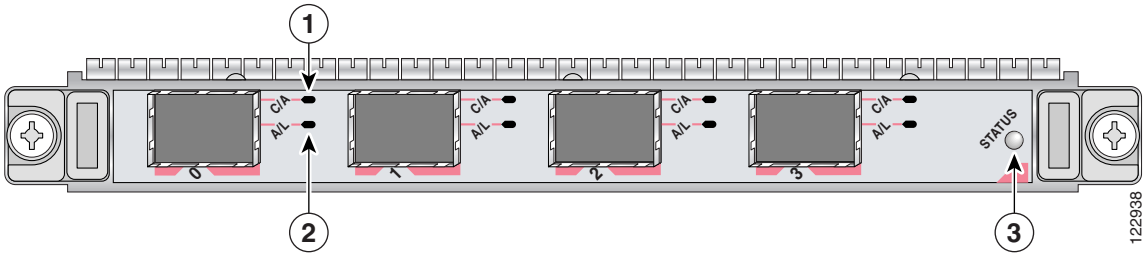
The 2-Port and 4-Port OC-3c/STM-1 POS SPAs are single-height SPAs that install into one SIP subslot. The OC-3c/STM-1 POS SPAs with small form-factor pluggable (SFP) optical transceiver modules provide SONET and SDH network connectivity with a per-port bandwidth of 155.52 Mbps. For more information about SPA bandwidth, see the "Bandwidth Oversubscription" section on page 3-3. For more information about SPAs and their compatibility with SIPs and modular optics, see the "SIP, SSC, and SPA Compatibility" section on page 1-3.

The following sections describe the 2-Port and 4-Port OC-3c/STM-1 POS SPA:

OC-3c/STM-1 POS SPA LEDs

The 2-Port and 4-Port OC-3c/STM-1 POS SPAs have three types of LEDs. There are two LEDs for each port on the SPA, and one Status LED. Figure 3-10 shows an example of these LEDs on a 4-Port OC-3c/STM-1 POS SPA.

Figure 3-10 4-Port OC-3c/STM-1 POS SPA Faceplate



1	C/A (Carrier/Alarm) LED	**3**	STATUS LED
2	A/L (Active Loopback) LED		

Table 3-11 describes the 2-Port and 4-Port OC-3c/STM-1 POS SPA LEDs.

Table 3-11 2-Port and 4-Port OC-3c/STM-1 POS SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and there is a valid SONET signal without any alarms.
	Amber	On	Port is enabled by software, and there is at least one alarm.
A/L	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, loopback is off.
	Amber	On	Port is enabled by software, loopback is on.
STATUS	Off	Off	SPA power is off.
	Amber	On	SPA power is on and good, and SPA is being configured.
	Green	On	SPA is ready and operational.

OC-3c/STM-1 POS SPA Interface Specifications

The framer processes incoming and outgoing SONET or SDH frames. The framer operates at OC-3c/STM-1 (155.52 Mbps) line rates.

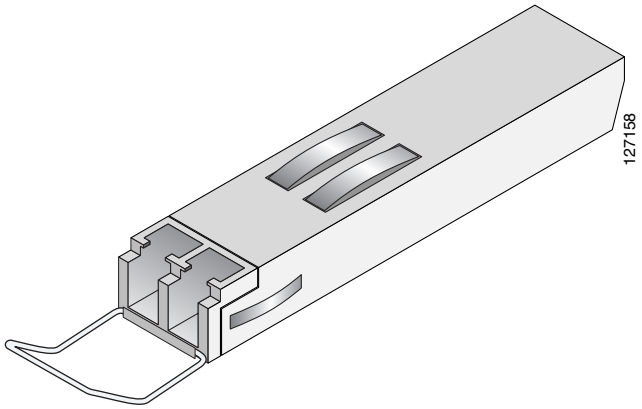
Packet data is transported with a user-configured encapsulation [such as Point-to-Point Protocol (PPP)] and is mapped into the STS-3c/STM-1 frame.

The OC-3c/STM-1 POS SPA interface is compliant with RFC 1619, *PPP over SONET/SDH*, and RFC 1662, *PPP in HDLC-like Framing*. The OC-3c/STM-1 POS SPA also provides support for SNMP agent v1 (RFC 1155-1157), and Management Information Base (MIB) II (RFC 1213).

OC-3c/STM-1 POS SPA SFP Optical Transceiver Modules and Cables

The POS SPA uses a small form-factor pluggable (SFP) optical transceiver module (see Figure 3-11) installed in each port for SONET and SDH single-mode and multimode optical fiber connection.

Figure 3-11 SFP Optics Module



The SFP optical transceiver modules used with the POS SPAs provide the following optical fiber options:

- Multimode—155-Mbps, OC-3c/STM-1 optical fiber (SONET STS-3c or SDH STM-1)

  Use a multimode optical fiber that has a core/cladding diameter of 62.5/125 microns.

- Single-mode—155-Mbps, OC-3c/STM-1 optical fiber (SONET STS-3c or SDH STM-1)

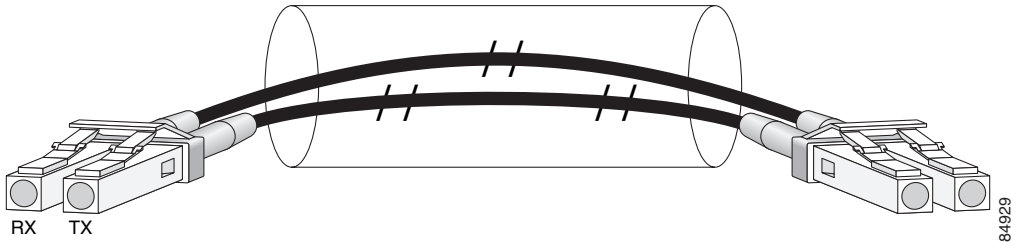
  Use a single-mode optical fiber that has a modal-field diameter of 8.7 ±0.5 microns. (Nominal diameter is approximately 10/125 microns.)

For single-mode and multimode optical fiber connections, you can use either a duplex LC-type cable (see Figure 3-12) or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

Use single-mode (for intermediate- or long-reach configurations) or multimode optical fiber cable to connect your router to a network or to connect two OC-3c/STM-1-equipped routers back to back.

Long-range SFP optical transceiver modules (for long-reach configurations) cannot be connected back-to-back without using an attenuator between the two of them.

Figure 3-12 LC Type Cables



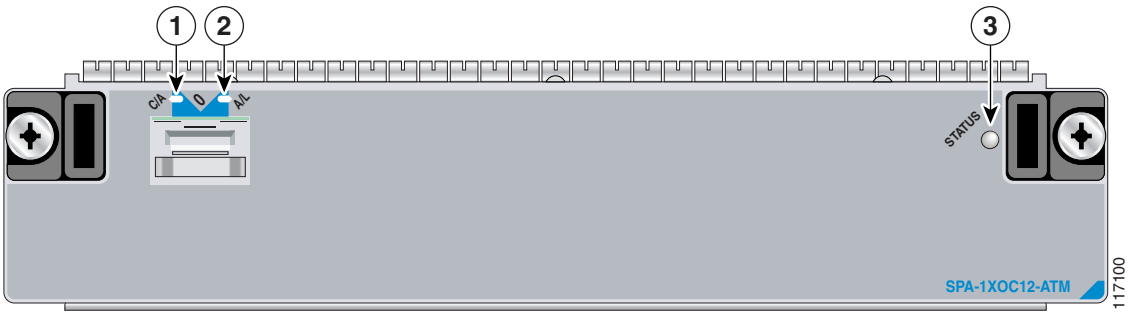
1-Port OC-12c/STM-4 ATM SPA Overview

The following sections describe the 1-Port OC-12c/STM-4 ATM SPA:

1-Port OC-12c/STM-4 ATM SPA LEDs

The 1-Port OC-12c/STM-4 ATM SPA has three types of LEDs. There are two LEDs for the port on the SPA, and one STATUS LED as shown in Figure 3-13.

Figure 3-13 1-Port OC-12c/STM-4 ATM SPA Faceplate



1	C/A (Carrier/Alarm) LED	**3**	STATUS LED
2	A/L (Active Loopback) LED		

Table 3-12 describes the 1-Port OC-12c/STM-4 ATM SPA LEDs.

Table 3-12 1-Port OC-12c/STM-4 ATM SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and there is a valid ATM signal without any alarms.
	Amber	On	Port is enabled by software, and there is at least one alarm.
A/L	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, loopback is off.
	Amber	On	Port is enabled by software, loopback is on.
STATUS	Off	Off	SPA power is off.
	Amber	On	SPA power is on and good, and SPA is being configured.
	Green	On	SPA is ready and operational.

1-Port OC-12c/STM-4 ATM SPA Interface Specifications

The physical layer interface for the 1-Port OC-12c/STM-4 ATM SPA is Optical Carrier-12 (OC-12), and the 1-Port OC-12c/STM-4 ATM SPA is designed to comply with ATM specifications. The 1-Port OC-12c/STM-4 ATM SPA provides one 622.08-Mbps OC-12 network interface for all supported platforms.

The single SPA port accepts an SFP module with a duplex LC-type receptacle that allows connection to single-mode or multimode optical fiber.

1-Port OC-12c/STM-4 ATM SPA Cables and Connectors

The 1-Port OC-12c/STM-4 ATM SPA provides the following optical fiber options:

- Multimode—622.08-Mbps, OC-12 optical fiber (SONET STS-12c or SDH STM-4)

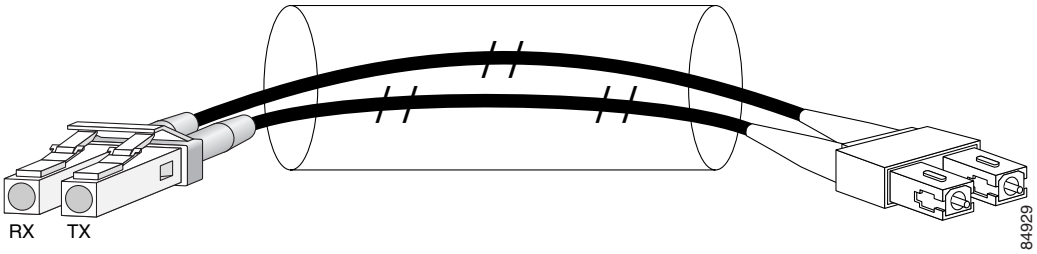
  Use a multimode optical fiber that has a core/cladding diameter of 62.5/125 microns.

- Single-mode—622.08-Mbps, OC-12 optical fiber (SONET STS-12c or SDH STM-4)

  Use a single-mode optical fiber that has a modal-field diameter of 8.7 ±0.5 microns. (Nominal diameter is approximately 10/125 microns.)

For single-mode and multimode optical fiber connections, you can use either a duplex LC-type cable (see Figure 3-14) or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

Figure 3-14 Duplex Patch Cable with LC-Type Connectors



1-Port OC-12c/STM-4 POS SPA Overview

The 1-Port OC-12c/STM-4 POS SPA is single-height SPA that installs into one SIP subslot. The 1-Port OC-12c/STM-4 POS SPA with a small form-factor pluggable (SFP) optical transceiver module provides SONET and SDH network connectivity with a bandwidth of 622.08 Mbps.

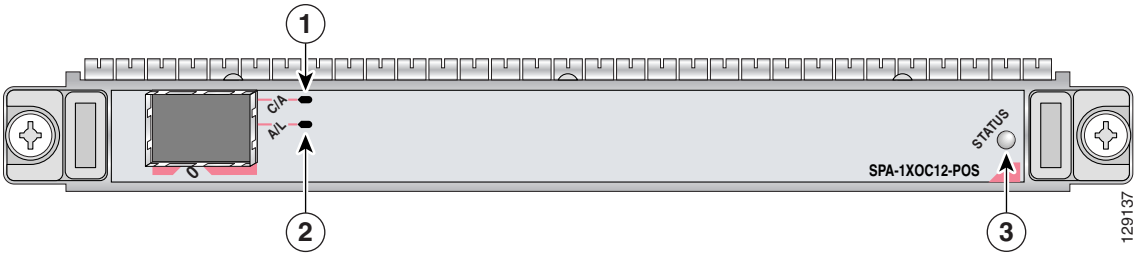
For more information about SPA bandwidth, see the "Bandwidth Oversubscription" topic in this chapter. For more information about SPAs and their compatibility with SIPs and modular optics, see the "SIP and SPA Product Overview" chapter in this guide.

The following sections describe the 1-Port OC-12c/STM-4 POS SPA:

1-Port OC-12c/STM-4 POS SPA LEDs

The 1-Port OC-12c/STM-4 POS SPA has three types of LEDs. There are two LEDs for each port on the SPA, and one STATUS LED. Figure 3-15 shows an example of these LEDs on a 1-Port OC-12c/STM-4 POS SPA.

Figure 3-15 1-Port OC-12c/STM-4 POS SPA Faceplate



1	C/A (Carrier/Alarm) LED	**3**	STATUS LED
2	A/L (Active Loopback) LED		

Table 3-13 describes the 1-Port OC-12c/STM-4 POS SPA LEDs.

Table 3-13 1-Port OC-12c/STM-4 POS SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and there is a valid SONET signal without any alarms.
	Amber	On	Port is enabled by software, and there is at least one alarm.
A/L	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, loopback is off.
	Amber	On	Port is enabled by software, loopback is on.

Table 3-13 1-Port OC-12c/STM-4 POS SPA LEDs (continued)

LED Label	Color	State	Meaning
STATUS	Off	Off	SPA power is off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and good; SPA is being configured.

1-Port OC-12c/STM-4 POS SPA Interface Specifications

The framer processes incoming and outgoing SONET or SDH frames. The framer operates at OC-12c/STM-4 line rates (622.08 Mbps).

Packet data is transported with a user-configured encapsulation (such as Point-to-Point Protocol [PPP]) and is mapped into the STS-12c/STM-4 frame.

The 1-Port OC-12c/STM-4 POS SPA interface is compliant with the following RFCs:

- RFC 1619, *PPP over SONET/SDH*
- RFC 1662, *PPP in HDLC-like Framing*

The 1-Port OC-12c/STM-4 POS SPA also provides support for SNMP v1 agent (RFC 1155–1157) and RFC 1213:

- RFC 1155, *Structure and Identification of Management Information for TCP/IP-based Internets*
- RFC 1156, *Management Information Base for Network Management of TCP/IP-Based Internets*
- RFC 1157, *Simple Network Management Protocol (SNMP)*
- RFC 1213, *Management Information Base (MIB) for Network Management of TCP/IP-Based Internets:MIB II*.

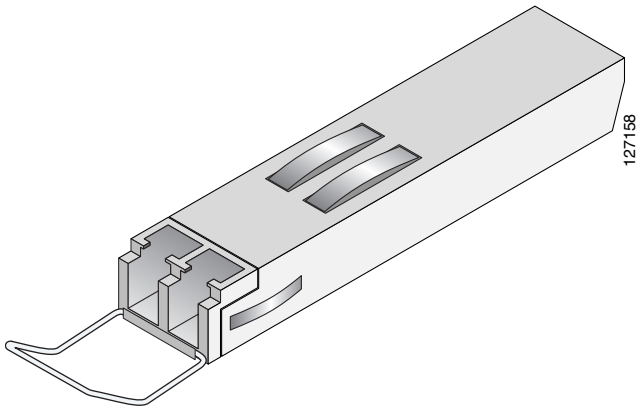
1-Port OC-12c/STM-4 POS SPA SFP Optical Transceiver Modules and Cables

The POS SPA uses a small form-factor pluggable (SFP) optical transceiver module installed in each port for SONET and SDH single-mode and multimode optical fiber connection (see Figure 3-16).

Cisco Systems qualifies the optics that are approved for use with its SPAs. The 1-Port OC-12c/STM-4 POS SPA supports the following types of optical transceiver modules:

- Multimode (MM) SFP module—SFP-OC12-MM
- Short reach (SR) SFP module—SFP-OC12-SR
- Intermediate reach (IR) SFP module (15 km)—SFP-OC12-IR1
- Long reach (LR) SFP module (40 km)—SFP-OC12-LR1
- LR SFP module (80 km)—SFP-OC12-LR2

Figure 3-16 SFP Optics Module



The SFP optical transceiver modules used with the POS SPAs provide the following optical fiber options:

- Multimode—622.08-Mbps, OC-12 optical fiber (SONET STS-12c or SDH STM-4)

  Use a multimode optical fiber that has a core/cladding diameter of 62.5/125 microns.

- Single-mode—622.08-Mbps, OC-12 optical fiber (SONET STS-12c or SDH STM-4)

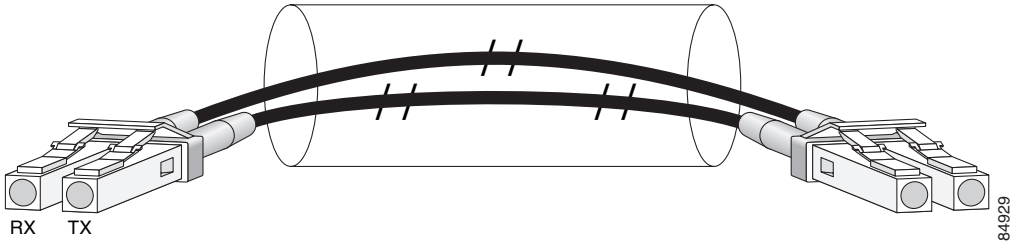
  Use a single-mode optical fiber that has a modal-field diameter of 8.7 ±0.5 microns. (Nominal diameter is approximately 10/125 microns.)

For single-mode and multimode optical fiber connections, you can use either a duplex LC-type cable (see Figure 3-17) or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

Use single-mode (for intermediate- or long-reach configurations) or multimode optical fiber cable to connect your router to a network or to connect two 1-Port OC-12c/STM-4 POS SPA-equipped routers back to back.

Long-range SFP optical transceiver modules (for long-reach configurations) cannot be connected back-to-back without using an attenuator between the two of them.

Figure 3-17 LC-Type Cable



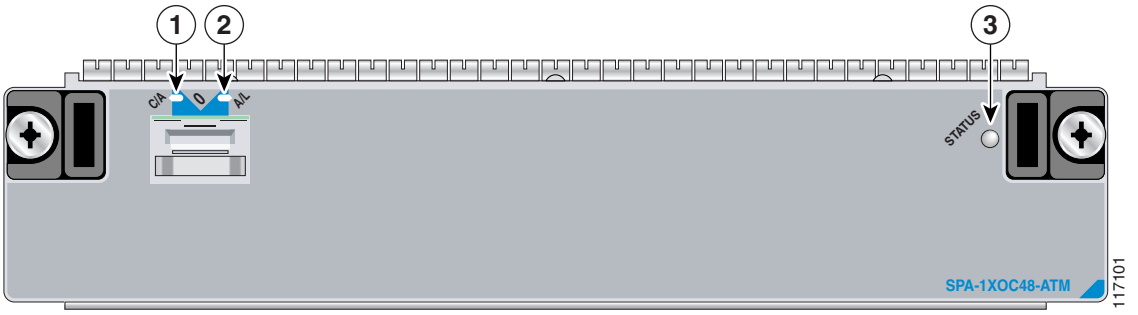
1-Port OC-48c/STM-16 ATM SPA Overview

The following sections describe the 1-Port OC-48c/STM-16 ATM SPA:

1-Port OC-48c/STM-16 ATM SPA LEDs

The 1-Port OC-48c/STM-16 ATM SPA has three LEDs, as shown in Figure 3-18.

Figure 3-18 1-Port OC-48c/STM-16 ATM SPA Faceplate



1	C/A (Carrier Alarm) LED	**3**	STATUS LED
2	A/L (Active Loopback) LED		

Table 3-14 describes the 1-Port OC-48c/STM-16 ATM SPA LEDs.

Table 3-14 1-Port OC-48c/STM-16 ATM SPA LEDs

LED Label	Color	State	Meaning
A/L	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, loopback is off.
	Amber	On	Port is enabled by software, loopback is on.
C/A	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and there is a valid ATM signal without any alarms.
	Amber	On	Port is enabled by software, and there is at least one alarm.
STATUS	Off	Off	SPA power is off.
	Amber	On	SPA power is on and good, and SPA is being configured.
	Green	On	SPA is ready and operational.

1-Port OC-48c/STM-16 ATM SPA Interface Specifications

The physical layer interface for the 1-port OC-48 ATM SPA is Optical Carrier-48 (OC-48), and the 1-port OC-48 ATM SPA is designed to comply with ATM specifications. The 1-port OC-48 ATM SPA provides one 2.488-Gbps ATM network interface for all supported platforms.

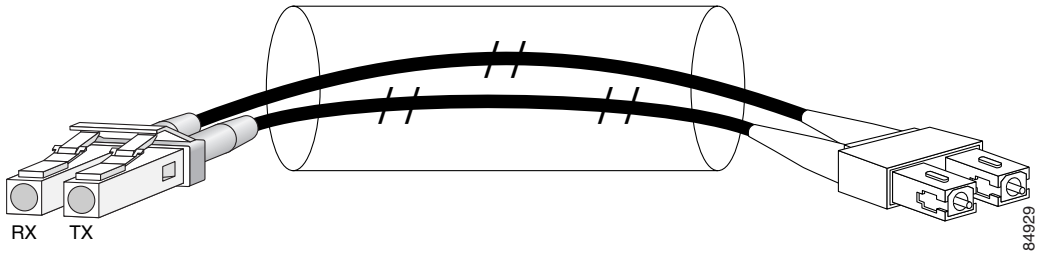
Each 1-port OC-48 ATM SPA has one duplex LC-type receptacle that allows connection to single-mode optical fiber.

1-Port OC-48c/STM-16 ATM SPA Cables and Connectors

Use single-mode (for intermediate-configurations) optical fiber cable to connect your router to a network or to connect two OC-48-equipped routers back-to-back.

The SPA-OC48 accepts an SFP module with a duplex LC-type receptacle that allows connection to single-mode optical fiber. For single-mode optical fiber connections, you can use either a duplex LC-type cable (see Figure 3-19) or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

Figure 3-19 Duplex Patch Cable with LC-Type Connectors



2-Port OC-48 POS/RPR SPA Overview

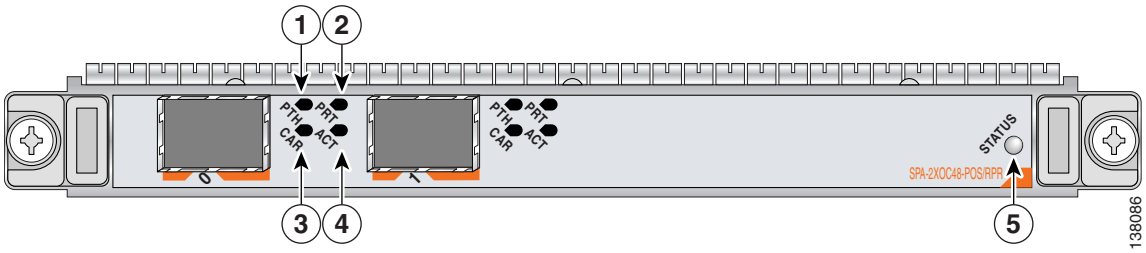
The following sections describe the 2-Port OC48-POS/RPR SPA:

- 2-Port OC48-POS/RPR SPA LEDs, page 3-26
- 2-Port OC48-POS/RPR SPA Interface Specifications, page 3-27
- 2-Port OC48-POS/RPR SPA Cables, Optical Transceiver Modules, and Connectors, page 3-27

2-Port OC48-POS/RPR SPA LEDs

The 2-Port OC48-POS/RPR SPA has five LEDs, as shown in Figure 3-20.

Figure 3-20 2-Port OC48-POS/RPR SPA Faceplate



1	PTH (Pass-Through) LED	**4**	ACT (Active Loopback) LED
2	PRT (Protect) LED	**5**	STATUS LED
3	CAR (Carrier/Alarm) LED		

Table 3-15 describes the 2-Port OC48-POS/RPR SPA LEDs.

Table 3-15 2-Port OC48-POS/RPR SPA LEDs

LED Label	Color	State	Meaning
PTH	Off	Off	Port is not in pass-through mode.
	Amber	On	Port is in pass-through mode.
CAR	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and there is a valid SONET signal without any alarms.
	Amber	On	Port is enabled by software, and there is at least one alarm.
	Amber	Blinking	Port is enabled by software, and there is a side mismatch.
PRT	Off	Off	Port is not in wrap mode or steer.
	Green	On	A node on the ring is wrapped.
	Green	Blinking	A node on the ring is steering pass-through
	Amber	On	Port is locally wrapped
	Amber	Blinking	Port is locally steering
ACT	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, loopback is off.
	Amber	On	Port is enabled by software, loopback is on.
STATUS	Off	Off	SPA power is off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and good, and SPA is being configured.

2-Port OC48-POS/RPR SPA Interface Specifications

The physical layer interface for the 2-Port OC48-POS/RPR SPA is Optical Carrier-48 (OC-48), and the 2-Port OC48-POS/RPR SPA is designed to comply with POS specifications. The 2-Port OC48-POS/RPR SPA provides two 2.488-Gbps network interfaces for all supported platforms.

2-Port OC48-POS/RPR SPA Cables, Optical Transceiver Modules, and Connectors

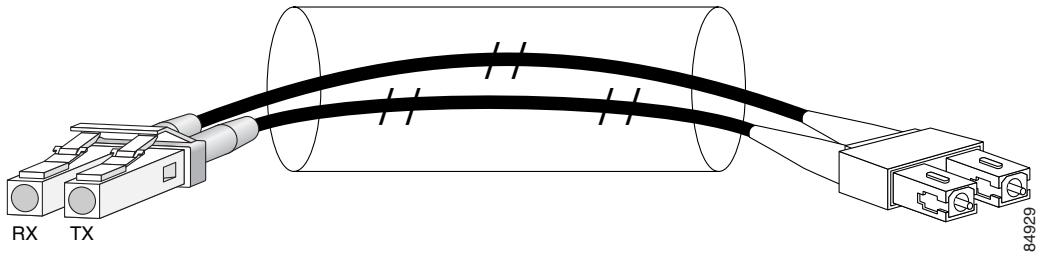
Use single-mode (for intermediate-configurations) optical fiber cable to connect your router to a network or to connect two OC-48-equipped routers back-to-back.

The 2-Port OC48-POS/RPR SPA supports the following types of optical transceiver modules:

- Single-mode short-reach (SR) SFP module—SFP-OC48-SR
- Single-mode intermediate-reach (IR) SFP module —SFP-OC48-IR1
- Single-mode long-reach (LR) SFP module — SFP-OC48-LR2

Each port on the 2-Port OC48-POS/RPR SPA has one duplex LC-type receptacle. For single-mode optical fiber connections, you can use either a duplex LC-type cable (see Figure 3-21) or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

Figure 3-21 Duplex Patch Cable with LC-Type Connectors



1-Port OC-192c/STM-64 POS/RPR SPA Overview

The 1-Port OC-192c/STM-64 POS/RPR SPA is a double-height SPA that is installed in two SIP subslots. The 1-Port OC-192c/STM-64 POS/RPR SPA provides SONET and SDH network connectivity with a bandwidth of 9.95 Gbps.

For more information about SPA bandwidth, see the "Bandwidth Oversubscription" section on page 3-3. For more information about SPAs and their compatibility with SIPs and modular optics, see the "SIP, SSC, and SPA Compatibility" section on page 1-3.

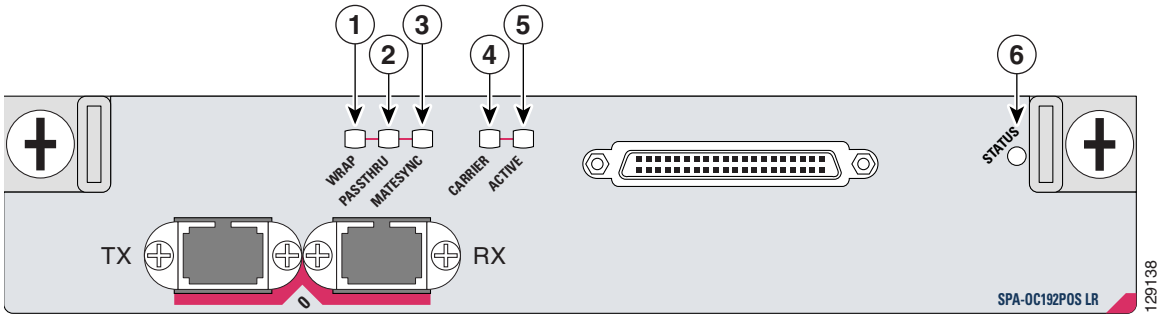
The 1-Port OC-192c/STM-64 POS/RPR SPA uses a single,10-Gbps fixed optical receptacle allowing a connection to single-mode optical fiber. For more information on the optical fiber cables used with this SPA, see the "1-Port OC-192c/STM-64 POS/RPR SPA Fixed Optical Transceiver, 40-Pin Connector, and Cables" section on page 3-29.

The following sections describe the 1-Port OC-192c/STM-64 POS/RPR SPA:

1-Port OC-192c/STM-64 POS/RPR SPA LEDs

The 1-Port OC-192c/STM-64 POS/RPR SPA has six LEDs, as shown in Figure 3-22.

Figure 3-22 1-Port OC-192c/STM-64 POS/RPR SPA Faceplate



1	WRAP LED	**4**	CARRIER LED
2	PASSTHRU LED	**5**	ACTIVE LED
3	MATESYNC LED	**6**	STATUS LED

Note The WRAP, PASSTHRU, and MATESYNC LEDs apply to the SPA in RPR/SRP mode only. In Cisco IOS Release 12.0(31)S, RPR/SRP mode is not supported.

Table 3-16 describes the 1-Port OC-192c/STM-64 POS/RPR SPA LEDs.

Table 3-16 1-Port OC-192c/STM-64 POS/RPR SPA LEDs

LED Label	Color	State	Meaning
WRAP	Off	Off	Port is not in wrap mode.
	Green	On	Port is in wrap mode somewhere on the ring.
	Amber	On	Port is in wrap mode locally.
PASSTHRU	Off	Off	Port is not in pass-thru mode.
	Amber	On	Port is in pass-thru mode.
MATESYNC	Off	Off	Mate port is not synchronized.
	Green	On	Mate port is synchronized.
CARRIER	Off	Off	Port is not enabled by software.

Table 3-16 1-Port OC-192c/STM-64 POS/RPR SPA LEDs (continued)

LED Label	Color	State	Meaning
	Green	On	Port is enabled by software; there is a valid SONET signal without alarms.
	Amber	On	Port is enabled by software; there is at least one alarm (LOS, LOF, RDI, and so on).
		Blinking	Indicates SRP mode mismatch alarm.
ACTIVE	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software; loopback is off.
	Amber	On	Port is enabled by software; loopback is on.
STATUS	Off	Off	SPA power off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and good; SPA is being configured.

1-Port OC-192c/STM-64 POS/RPR SPA Interface Specifications

The 1-Port OC-192c/STM-64 POS/RPR SPA contains a SONET/SDH framer to process incoming and outgoing SONET or SDH frames. The framer operates at OC-192/STM-64 line rates (9.95 Gbps).

Packet data is transported with a user-configured encapsulation (such as Point-to-Point Protocol [PPP]) and is mapped into the STS-192c/STM-64 frame.

The 1-Port OC-192c/STM-64 POS/RPR SPA interface is compliant with the following RFCs:

- RFC 1619, *PPP over SONET/SDH*
- RFC 1662, *PPP in HDLC-like Framing*
- RFC 2615, *PPP over SONET/SDH*

The 1-Port OC-192c/STM-64 POS/RPR SPA also provides support for SNMP v1 agent (RFC 1155–1157) and RFC 1213:

- RFC 1155, *Structure and Identification of Management Information for TCP/IP-Based Internets*
- RFC 1156, *Management Information Base for Network Management of TCP/IP-Based Internets*
- RFC 1157, *Simple Network Management Protocol (SNMP)*
- RFC 1213, *Management Information Base (MIB) for Network Management of TCP/IP-Based Internets:MIB II*

1-Port OC-192c/STM-64 POS/RPR SPA Fixed Optical Transceiver, 40-Pin Connector, and Cables

The 1-Port OC-192c/STM-64 POS/RPR SPA uses fixed optical transceivers, one for receive (RX) and one for transmit (TX), for SONET and SDH connection to the network. In Cisco IOS Release 12.0(31)S, only long-reach (LR) optics are supported.

Cisco Systems qualifies the optics that are approved for use with its SPAs. Check the product overview section of this guide to determine which optical transceiver modules are qualified for use.

The 1-Port OC-192c/STM-64 POS/RPR SPA uses single-mode SC-type connectors:

- Single-mode—9.95 Gbps, OC-192 optical fiber (SONET STS-192c or SDH STM-64c)

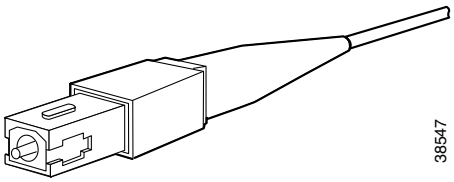
Use a single-mode optical fiber that has a modal-field diameter of 8.7 ±0.5 microns. (Nominal diameter is approximately 10/125 microns.)

Use a single-mode optical fiber cable to connect your router to a network.

Note The 40-pin connector on the 1-Port OC-192c/STM-64 POS/RPR SPA is used for resilient packet ring (RPR) connections. Support for the RPR feature is dependent on the platform software release feature content. Verify support for the RPR feature using SPA datasheets or by contacting your Cisco representative.

Figure 3-23 shows the cable type for use with the fixed optical transceiver module on the 1-Port OC-192c/STM-64 POS/RPR SPA.

Figure 3-23 SC-Type Connectors for the Fixed Optical Transceivers



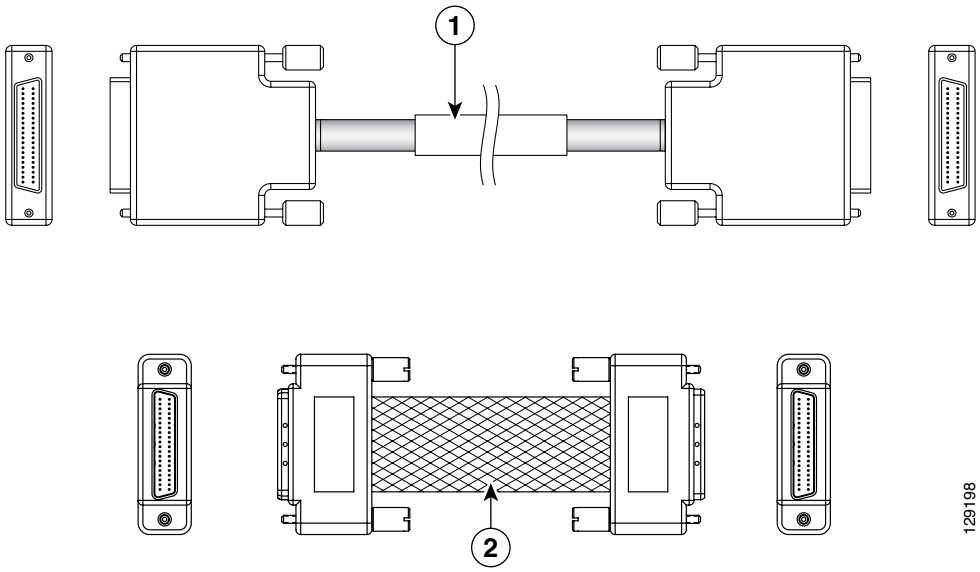
Mate Interface Cables

The 1-Port OC-192c/STM-64 POS/RPR SPA supports two mate interface configurations:

- Mate between two OC-192c SPAs in the same SIP
- Mate between two OC-192c SPAs in adjacent SIPs

Two 1-Port OC-192c/STM-64 POS/RPR SPAs are connected using a 40–pin connector copper mate cable. The length of the cables allow only two possible connection scenarios, next slot horizontal and same slot vertical. This assumes that the chassis is mounted vertically. Figure 3-24 shows the mate cables used to connect the SPAs.

Figure 3-24 SPA Mate Cables



1	Long length RPR mate cable for single port RPR SPAs (CBL-RPR-OC192-L)	2	Short length RPR mate cable for single port RPR SPAs (CAB-RPR-OC192-S)

1-Port OC-192c/STM-64 POS/RPR XFP SPA Overview

The 1-Port OC-192c/STM-64 POS/RPR XFP SPA is a single-height SPA that is installed in one SIP subslot. The 1-Port OC-192c/STM-64 POS/RPR XFP SPA provides SONET and SDH network connectivity with a bandwidth of 9.95 Gbps.

For more information about SPA bandwidth, see the "Bandwidth Oversubscription" section on page 3-3. For more information about SPAs and their compatibility with SIPs and modular optics, see the product overview chapter in this guide.

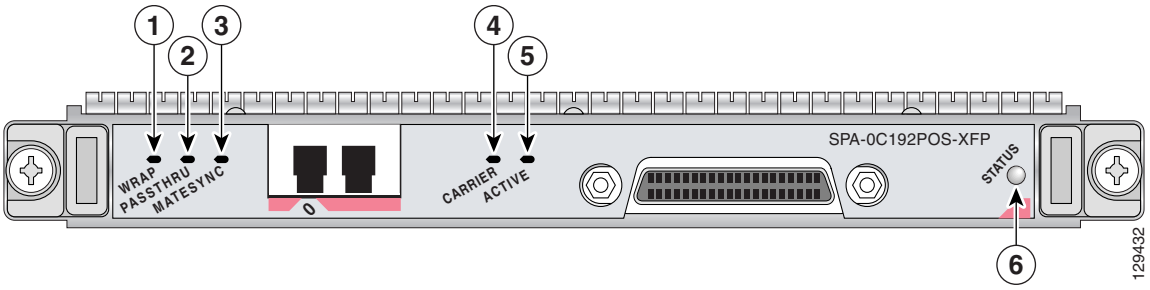
The 1-Port OC-192c/STM-64 POS/RPR XFP SPA uses a 10-Gbps small form-factor pluggable optical receptacle for each port allowing connection to single-mode optical fiber. For more information on the optical fiber cables used with this SPA, see the "OC-3c/STM-1 POS SPA SFP Optical Transceiver Modules and Cables" section on page 3-16.

The following sections describe the 1-Port OC-192c/STM-64 POS/RPR XFP SPA:

1-Port OC-192c/STM-64 POS/RPR XFP SPA LEDs

The 1-Port OC-192c/STM-64 POS/RPR XFP SPA has six LEDs, as shown in Figure 3-25.

Figure 3-25 1-Port OC-192c/STM-64 POS/RPR XFP SPA Faceplate



1	WRAP LED	**4**	CARRIER LED
2	PASSTHRU LED	**5**	ACTIVE LED
3	MATESYNC LED	**6**	STATUS LED

Note The WRAP, PASSTHRU, and MATESYNC LEDs apply to the SPA in RPR/SRP mode only. Support for the RPR/SRP feature is dependent on the platform software release feature content. Verify support for the RPR/SRP feature using SPA datasheets or by contacting your Cisco representative.

Table 3-17 describes the 1-Port OC-192c/STM-64 POS/RPR XFP SPA LEDs.

Table 3-17 1-Port OC-192c/STM-64 POS/RPR XFP SPA LEDs

LED Label	Color	State	Meaning
WRAP	Off	Off	Port is not in wrap mode.
	Green	On	Port is in wrap mode somewhere on the ring.
	Amber	On	Port is in wrap mode locally.
PASSTHRU	Off	Off	Port is not in pass-thru mode.
	Amber	On	Port is in pass-thru mode.
MATESYNC	Off	Off	Mate port is not synchronized.
	Green	On	Mate port is synchronized.
CARRIER	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and there is a valid SONET signal without alarms.
	Amber	On	Port is enabled by software, and there is at least one alarm (LOS, LOF, RDI, and so on).
		Blinking	SRP mode mismatch alarm is indicated.

Table 3-17 1-Port OC-192c/STM-64 POS/RPR XFP SPA LEDs (continued)

LED Label	Color	State	Meaning
ACTIVE	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and loopback is off.
	Amber	On	Port is enabled by software, and loopback is on.
STATUS	Off	Off	SPA power off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and good, and the SPA is being configured.

1-Port OC-192c/STM-64 POS/RPR XFP SPA Interface Specifications

The framer processes incoming and outgoing SONET or SDH frames. The framer operates at OC-192c/STM-64 line rates (9.95 Gbps).

Packet data is transported with a user-configured encapsulation (such as Point-to-Point Protocol [PPP]) and is mapped into the STS-192c/STM-64 frame.

The 1-Port OC-192c/STM-64 POS/RPR XFP SPA interface is compliant with the following RFCs:

- RFC 1662, *PPP in HDLC-like Framing*
- RFC 2615, *PPP over SONET/SDH*

1-Port OC-192c/STM-64 POS/RPR XFP SPA Optical Transceiver Modules, Connectors, and Cables

The 1-Port OC-192c/STM-64 POS/RPR XFP SPA uses a single-mode, 9.95 Gbps, OC-192c optical fiber (SONET STS-192c or SDH STM-64) optical transceiver module for SONET and SDH connection to the network.

The 1-Port OC-192c/STM-64 POS/RPR XFP SPA supports the following types of optical transceiver module:

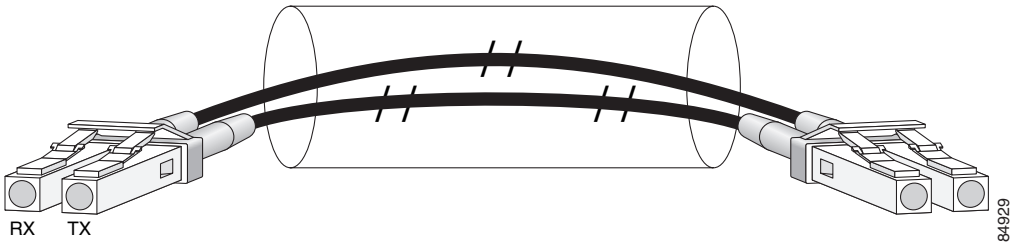
- Single-mode short-reach (SR) XFP module—XFP-10GLR-OC192SR
- Single-mode intermediate-reach (IR) XFP module—XFP-10GER-OC192IR
- Single-mode very-long reach XFP module—XFP-10GZR-OC192LR

Cisco Systems qualifies the optics that are approved for use with its SPAs. Check the product overview section of this guide to determine which optical transceiver modules are qualified for use.

Use a single-mode optical fiber that has a modal-field diameter of 8.7 ±0.5 microns (nominal diameter is approximately 10/125 microns) to connect your router to a network.

Figure 3-26 shows the cable type for use with the XFP optical transceiver module on the 1-Port OC-192c/STM-64 POS/RPR XFP SPA.

Figure 3-26 LC-Type Cable for the XFP Optical Transceiver Modules



Note The 40-pin connector on the 1-Port OC-192c/STM-64 POS/RPR XFP SPA is used for resilient packet ring (RPR) connections. Support for the RPR feature is dependent on the platform software release feature content. Verify support for the RPR feature using SPA datasheets or by contacting your Cisco representative.

OC-192 Module Connections

Table 3-18 shows the OC-192 specifications for use with the 1-Port OC-192c/STM-64 POS/RPR XFP SPA.

Table 3-18 OC-192 Specifications

Specification	Description
Wavelength	OC-192 SR-1: 1290 nm to 1330 nm OC-192 IR-2: 1530 nm to 1565 nm OC-192 LR-2: 1530 nm to 1565 nm
Cabling distance (maximum)	OC-192 SR-1: 2 km (1.2 miles) OC-192 IR-2: 40 km (24.8 miles) OC-192 LR-2: 50 miles (80 km)
Operating case temperature range	OC-192 SR-1: 23 to 158 degrees F (–5 to 70 degrees C) OC-192 IR-2: 23 to 158 degrees F (–5 to 70 degrees C) OC-192 LR-2: 23 to 158 degrees F (–5 to 70 degrees C)
Tx Power	OC-192 SR-1: –6 dBm –1 dBm OC-192 IR-2: –1 dBm +2 dBm OC-192 LR-2: 0 to +4 dBm
Receiver Sensitivity (maximum)	OC-192 SR-1: –11 dBm OC-192 IR-2: –14 dBm OC-192 LR-2: –24 dBm

Table 3-18 OC-192 Specifications (continued)

Specification	Description
RX Overload	OC-192 SR-1: –1 dBm OC-192 IR-2: +2 dBm OC-192 LR-2: –7.0 dBm
Maximum Receiver Power Damage	OC-192 SR-1: +5 dBm OC-192 IR-2: +5 dBm OC-192 LR-2: +5 dBm

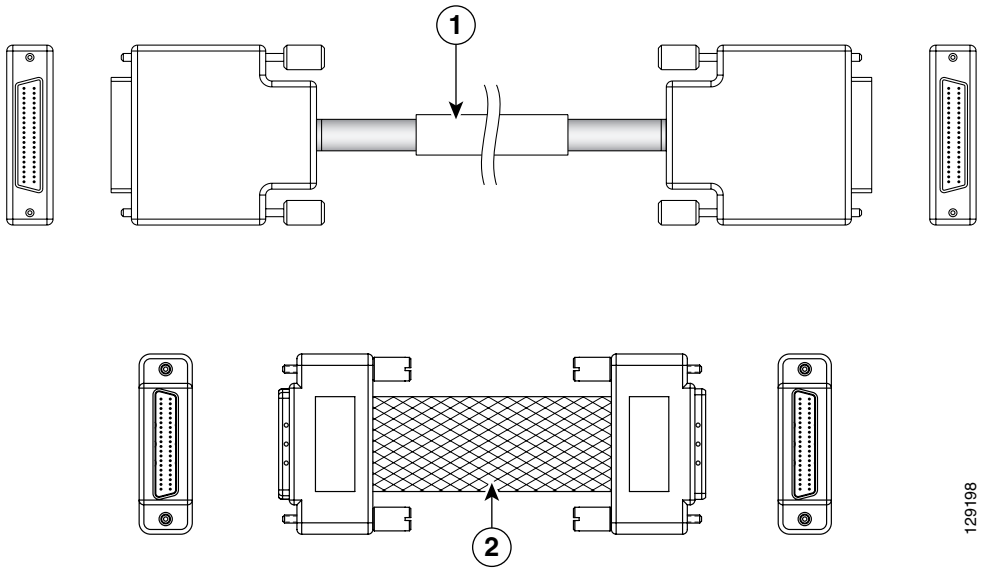
Mate Interface Cables

The 1-Port OC-192c/STM-64 POS/RPR XFP SPA supports two mate interface configurations:

- Mate between two OC-192c SPAs in the same SIP
- Mate between two OC-192c SPAs in adjacent SIPs

Two 1-Port OC-192c/STM-64 POS/RPR XFP SPAs are connected using a 40–pin connector copper mate cable. The length of the cables allow only two possible connection scenarios, next slot horizontal and same slot vertical. This assumes that the chassis is mounted vertically. Figure 3-27 shows the mate cables used to connect the SPAs.

Figure 3-27 SPA Mate Cables



1	Long length RPR mate cable for single port RPR SPAs (CBL-RPR-OC192-L)	2	Short length RPR mate cable for single port RPR SPAs (CAB-RPR-OC192-S)

Note The RPR mate cable is only necessary when the SPA is to be used in RPR mode. It is not needed in POS mode. Support for the RPR feature is dependent on the platform software release feature content. Verify support for the RPR feature using SPA datasheets or by contacting your Cisco representative.

1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA Overview

The 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA is a double-height SPA that is installed in a SIP subslot. The 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA provides SONET and SDH network connectivity with a bandwidth of 9.95 Gbps.

For more information about SPA bandwidth, see the "Bandwidth Oversubscription" section in this chapter. For more information about SPAs and their compatibility with SIPs and modular optics, see the "Product Overview" chapter in this guide.

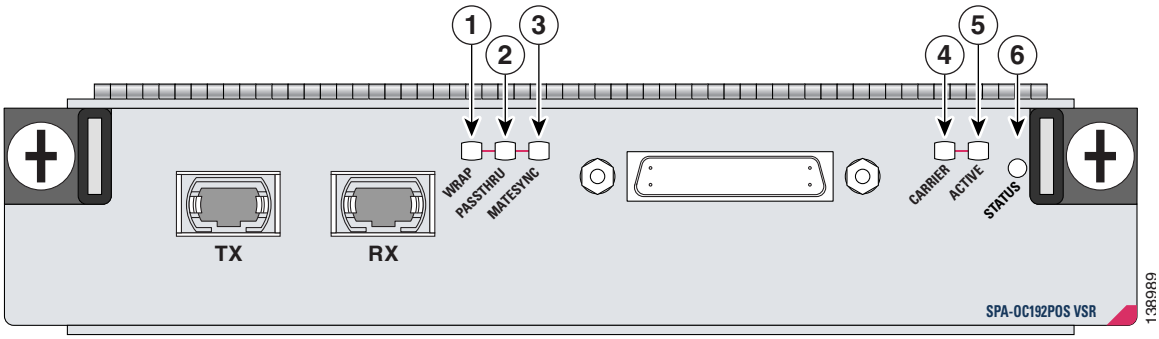
The 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA uses a single, 10-Gbps fixed optical receptacle allowing a connection to multimode optical fiber. For more information on the optical fiber cables used with this SPA, see the "1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA Fixed Optical Transceiver, 40-Pin Connector, and Cables" section on page 3-38.

The following sections describe the 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA:

1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA LEDs

The 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA has six LEDs, as shown in Figure 3-28.

Figure 3-28 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA Faceplate



1	WRAP LED	4	CARRIER LED
2	PASSTHRU LED	5	ACTIVE LED
3	MATESYNC LED	6	STATUS LED

Note The WRAP, PASSTHRU, and MATESYNC LEDs apply to the SPA in RPR/SRP mode only. Support for the RPR/SRP feature is dependent on the platform software release feature content. Verify support for the RPR/SRP feature using SPA datasheets or by contacting your Cisco representative.

Table 3-19 describes the 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA LEDs.

Table 3-19 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA LEDs

LED Label	Color	State	Meaning
WRAP	Off	Off	Port is not in wrap mode.
	Green	On	Port is in wrap mode somewhere on the ring.
	Amber	On	Port is in wrap mode locally.
PASSTHRU	Off	Off	Port is not in pass-through mode.
	Amber	On	Port is in pass-through mode.
MATESYNC	Off	Off	Mate port is not synchronized.
	Green	On	Mate port is synchronized.
CARRIER	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and there is a valid SONET signal without alarms.
	Amber	On	Port is enabled by software, and there is at least one alarm (LOS, LOF, RDI, and so on).
		Blinking	SRP mode mismatch alarm is indicated.
ACTIVE	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software, and loopback is off.
	Amber	On	Port is enabled by software, and loopback is on.
STATUS	Off	Off	SPA power off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and good, and the SPA is being configured.

1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA Interface Specifications

The 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA contains a SONET/SDH framer to process incoming and outgoing SONET or SDH frames. The framer operates at OC-192/STM-64 line rates (9.95 Gbps).

Packet data is transported with a user-configured encapsulation (such as Point-to-Point Protocol [PPP]) and is mapped into the STS-192c/STM-64 frame.

The 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA interface is compliant with the following RFCs:

- RFC 1662, *PPP in HDLC-like Framing*
- RFC 2615, *PPP over SONET/SDH*

1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA Fixed Optical Transceiver, 40-Pin Connector, and Cables

The 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA uses fixed optical transceivers, one for receive (RX) and one for transmit (TX), for SONET and SDH connection to the network. Only Very Short Reach (VSR) optics are supported.

The 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA uses multimode MTP-type connectors:

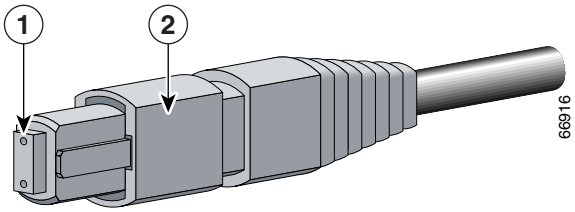
- Multimode—9.95 Gbps, OC-192 optical fiber (SONET STS-192c or SDH STM-64c)

  Use a multimode optical fiber that has a modal-field diameter of 8.7 ±0.5 microns. (Nominal diameter is approximately 10/125 microns.)

Use a multimode optical fiber cable to connect your router to a network.

Figure 3-29 shows the cable type for use with the fixed optic transceiver module on the 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA.

Figure 3-29 Simplex MTP Cable Connector (Multimode—VSR Only)



1	MTP female connector	**2**	Spring-action disconnect latch

Note The 40-pin connector on the 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA is used for resilient packet ring (RPR) connections. Support for the RPR feature is dependent on the platform software release feature content. Verify support for the RPR feature using SPA datasheets or by contacting your Cisco representative.

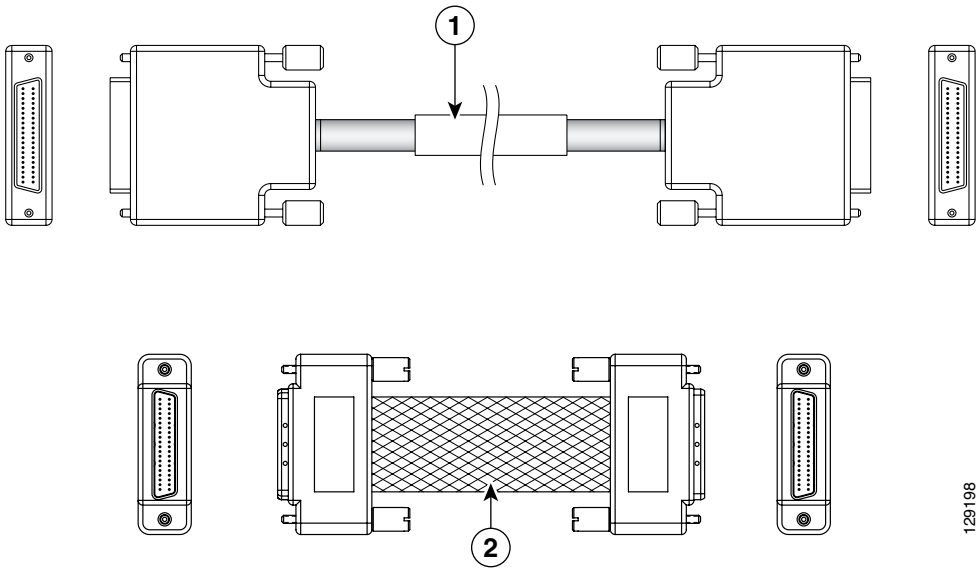
Mate Interface Cables

The 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPA supports two mate interface configurations:

- Mate between two OC-192c SPAs in the same SIP
- Mate between two OC-192c SPAs in adjacent SIPs

Two 1-Port OC-192c/STM-64 POS/RPR VSR Optics SPAs are connected using a 40–pin connector copper mate cable. The length of the cables allow only two possible connection scenarios, next slot horizontal and same slot vertical. This assumes that the chassis is mounted vertically. Figure 3-30 shows the mate cables used to connect the SPAs.

Figure 3-30 SPA Mate Cables



1	Long length RPR mate cable for single port RPR SPAs (CBL-RPR-OC192-L)	2	Short length RPR mate cable for single port RPR SPAs (CAB-RPR-OC192-S)

4-Port and 8-Port Fast Ethernet SPA Overview

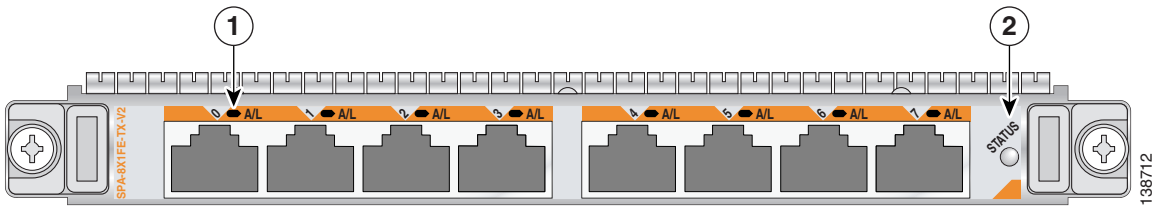
The following sections describe the 4-Port and 8-Port Fast Ethernet SPA:

- 4-Port and 8-Port Fast Ethernet SPA LEDs, page 3-39
- Cables, Connectors, and Pinouts, page 3-40

4-Port and 8-Port Fast Ethernet SPA LEDs

The 4-Port and 8-Port Fast Ethernet SPA has two types of LEDs. There is a port number Active/Link LED for each individual port and one STATUS LED. Figure 3-31 shows the 8-Port FastEthernet SPA ports and LEDs.

Figure 3-31 8-Port FastEthernet SPA Faceplate



1	A/L (Active/Link) LED	2	STATUS LED

Table 3-20 describes the 8-Port FastEthernet SPA LEDs.

Table 3-20 8-Port FastEthernet SPA LEDs

LED Label	Color	State	Meaning
A/L (Active/Link) (0, 1, 2, 3, 4, 5, 6 or 7)[1]	Green	On	The port is enabled and the link is up.
	Amber	On	The port is enabled and the link is down.
	Off	Off	The port is disabled.
STATUS	Green	On	The SPA is online.
	Amber	On	The SPA is receiving power and bootstrapping.
	Off	Off	The SPA is offline and deactivated.

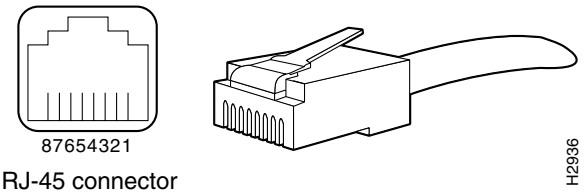
1. In this case, the port number refers to the numbered LEDs on the 8-Port FastEthernet SPA (0, 1, 2, 3, 4, 5, 6 or 7). Each LED number on the 8-Port FastEthernet SPA references a port on the SPA.

Cables, Connectors, and Pinouts

The interface connectors on the 4-Port and 8-Port Fast Ethernet SPA are four or eight individual RJ-45 receptacles. You can use all interface connectors simultaneously. Each connection supports IEEE 802.3 and Ethernet 10/100BASE-T interfaces compliant with appropriate standards. Cisco Systems does not supply Category 5 unshielded twisted-pair (UTP) RJ-45 cables; these cables are available commercially.

Figure 3-32 shows the RJ-45 connector. Table 3-21 lists the pinouts and signals for the RJ-45 connector.

Figure 3-32 RJ-45 Connections, Plug, and Receptacle



RJ-45 connector

Table 3-21 RJ-45 Connector Pinout

Pin	Description
1	Transmit data + (TxD+)
2	TxD–
3	Receive data + (RxD+)
6	RxD–

Note Referring to the RJ-45 pinout in Table 3-21, proper common-mode line terminations should be used for the unused Category 5 UTP cable pairs 4/5 and 7/8. Common-mode termination reduces the contributions to electromagnetic interference (EMI) and susceptibility to common-mode sources. Wire pairs 4/5 and 7/8 are actively terminated in the RJ-45 port circuitry in the 4-Port and 8-Port Fast Ethernet SPA.

The 4-Port and 8-Port Fast Ethernet SPA supports automatic MDI/MDIX crossover at all speeds of operation allowing the SPA to work with straight-through and crossover Ethernet cables. Depending on your RJ-45 interface cabling requirements, use the pinouts in Figure 3-33 and Figure 3-34.

Figure 3-33 Straight-Through Cable Pinout, RJ-45 Connection to a Hub or Repeater

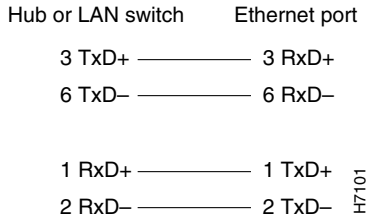
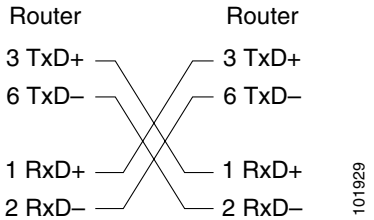


Figure 3-34 Crossover Cable Pinout, RJ-45 Connections Between Routers



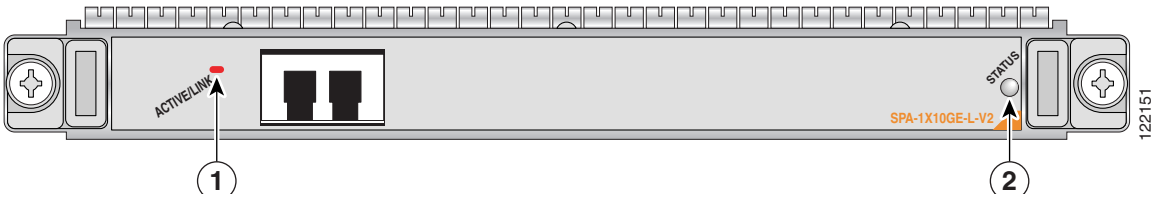
1-Port 10-Gigabit Ethernet SPA Overview

The following sections describe the 1-Port 10-Gigabit Ethernet SPA:

1-Port 10-Gigabit Ethernet SPA LEDs

The 1-Port 10-Gigabit Ethernet SPA has two types of LEDs. There is an ACTIVE/LINK LED for the port and the STATUS LED as shown in Figure 3-35.

Figure 3-35 1-Port 10-Gigabit Ethernet SPA Faceplate



1	ACTIVE/LINK LED	2	STATUS LED

Table 3-22 describes the 1-Port 10-Gigabit Ethernet SPA LEDs.

Table 3-22 1-Port 10-Gigabit Ethernet SPA LEDs

LED Label	Color	State	Meaning
ACTIVE/LINK	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software and the link is up.
	Amber	On	Port is enabled by software and the link is down.
STATUS	Off	Off	SPA power is off.
	Amber	On	SPA power is on and the SPA is being configured.
	Green	On	SPA is ready and operational.

1-Port 10-Gigabit Ethernet SPA Cables, Connectors, and Pinouts

The interface connector on the 1-Port 10-Gigabit Ethernet SPA is a fiber optic receiver that supports one small form factor pluggable (XFP) module.

XFP Connections

The XFP-10GLR-OC192SR and XFP-10GER-OC192IR XFPs include an optical transmitter and receiver pair integrated with Clock and Data Recovery (CDR) integrated circuits. The XFPs provide high-speed serial links at the following rates: 9.95 Gbps (OC-192) and 10.3125 Gbps (10-Gigabit Ethernet) on single mode fibers. The transmit side recovers and retimes the 10-Gbps serial data and passes it to a laser driver. The laser driver biases and modulates a 1310 nm or 1550 nm laser, enabling data transmission over SMF through an LC connector. The receive side recovers and retimes the 10-Gbps optical data stream from a photo detector trans impedance amplifier and passes it to an output driver.

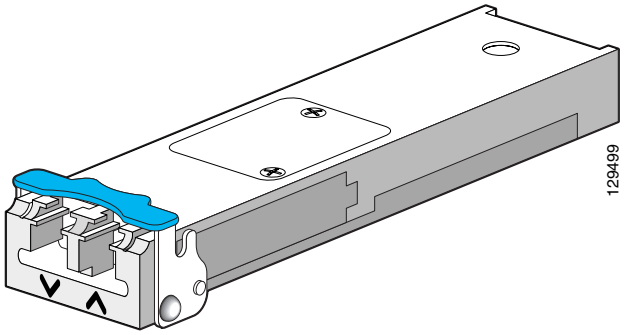
See the label on the XFP for technology type and model.

The XFP module dimensions are as follows:

- Height 12.5 mm
- Width 18.35 mm
- Length 71.1mm

The XFP module temperature range is 0° to 70°C (32° to 158°F). Figure 3-36 shows an XFP module.

Figure 3-36 XFP Module



XFP Port Cabling Specifications

Table 23 XFP Port Cabling Specifications

XFP	Wavelength	Fiber Type
XFP-10GLR-OC192SR	1310 nm	SMF
XFP-10GER-OC192IR	1550 nm	SMF

2-Port Gigabit Ethernet SPA Overview

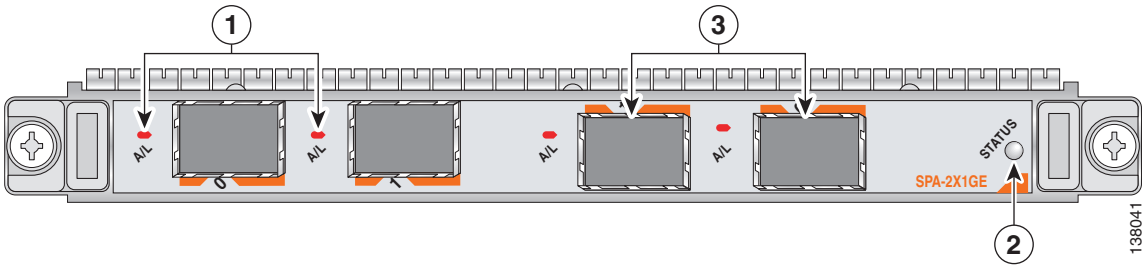
The following sections describe the version 1 and version 2 of the 2-Port Gigabit Ethernet SPA:

- 2-Port Gigabit Ethernet SPA LEDs, page 3-44
- 2-Port Gigabit Ethernet SPA (Version 2) LEDs, page 3-45
- SFP Module Cabling and Connection Equipment, page 3-48

2-Port Gigabit Ethernet SPA LEDs

The 2-Port Gigabit Ethernet SPA has two types of LEDs: an A/L LED for each port and a STATUS LED, as shown in Figure 3-37.

Figure 3-37 2-Port Gigabit Ethernet SPA Faceplate



1	A/L (Active/Link) LED	**2**	STATUS LED

Table 3-24 describes the 2-Port Gigabit Ethernet SPA LEDs.

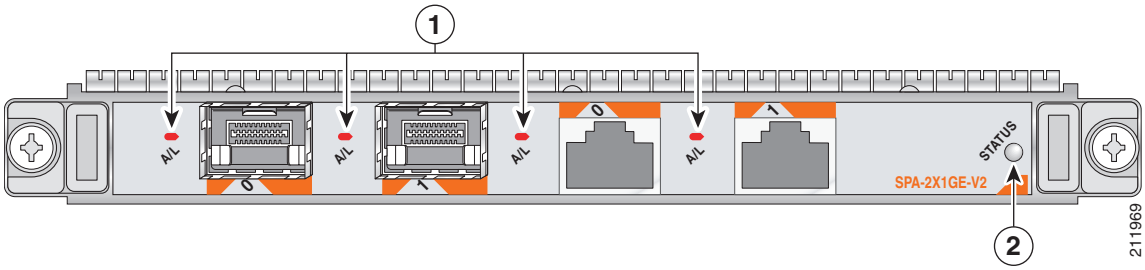
Table 3-24 2-Port Gigabit Ethernet SPA LEDs

LED Label	Color	State	Meaning
A/L	Off	Off	Port is not enabled.
	Green	On	Port is enabled and the link is up.
	Amber	On	Port is enabled and the link is down.
STATUS	Off	Off	SPA power is off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and good, and SPA is being configured.

2-Port Gigabit Ethernet SPA (Version 2) LEDs

The 2-Port Gigabit Ethernet SPA (Version 2) has two types of LEDs: an A/L LED for each port (SFP and RJ45) and a STATUS LED, as shown in Figure 3-38.

Figure 3-38 2-Port Gigabit Ethernet SPA (Version 2) Faceplate



1	A/L (Active/Link) LED	2	STATUS LED

Table 3-25 describes the 2-Port Gigabit Ethernet SPA (Version 2) LEDs.

Table 3-25 2-Port Gigabit Ethernet SPA (Version 2) LEDs

LED Label	Color	State	Meaning
A/L	Off	Off	Port is not enabled.
	Green	On	Port is enabled by software and the link is up.
	Amber	On	Port is enabled by software and the link is down.
STATUS	Off	Off	SPA power is off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and the SPA is being configured.

The valid configuration of the SFP and RJ45 ports for the 2-Port Gigabit Ethernet SPA (Version 2) are as follows:

- Port 0 (SFP) and Port 1 (SFP)
- Port 0 (SFP) and Port 1 (RJ45)
- Port 0 (RJ45) and Port 1 (SFP)
- Port 0 (RJ45) and Port 1 (RJ45)

or any single port

2-Port Fast Ethernet SPA Cables, Connectors, and Pinouts

The interface connectors on the 2-Port Fast Ethernet SPA are two individual RJ-45 receptacles. You can use both the interface connectors simultaneously. Each connection supports IEEE 802.3 and Ethernet 10/100BASE-T interfaces compliant with appropriate standards. Cisco Systems does not supply Category 5 unshielded twisted pair (UTP) RJ-45 cables; these cables are available commercially. The RJ-45 connectors are shown in Figure 3-39.

Figure 3-39 2-Port Fast Ethernet RJ-45 Connections, Plug, and Receptacle

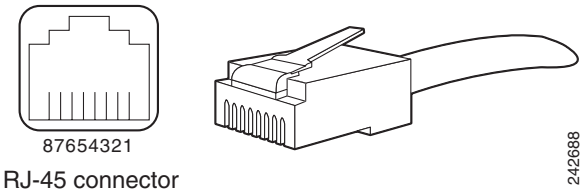


Table 3-26 lists the pinouts and signals for the RJ-45 connector.

Table 3-26 2-Port Fast Ethernet RJ-45 Connector Pinouts

Pin	Description
1	Transmit data + (TxD+)
2	TxD–
3	Receive data + (RxD+)
4	Reserved
5	Reserved
6	RxD–
7	Reserved
8	Reserved

2-Port Gigabit Ethernet SPA Cables and Connectors

The interface connectors on the 2-Port Gigabit Ethernet SPA are two individual fiber-optic receivers that support SFP modules. Each port can send and receive traffic using the optical fiber connections.

SFP Module Connections

The small form-factor pluggable (SFP) module is an input/output (I/O) device that plugs into the Gigabit Ethernet ports on the 2-Port Gigabit Ethernet SPA, linking the port with a fiber-optic network.

Note The 2-Port Gigabit Ethernet SPA will only accept the SFP modules listed as supported in this document. An SFP module check is run every time an SFP module is inserted into the 2-Port Gigabit Ethernet SPA, and only SFP modules that pass this check can be used by the 2-Port Gigabit Ethernet SPA.
SFP modules exist for technologies other than Gigabit Ethernet and for products other than the 2-Port Gigabit Ethernet SPA. However, the information in this document pertains only to SFP modules that plug into the 2-Port Gigabit Ethernet SPA ports.

The SFP module has a receiver port (RX) and a transmitter port (TX) that compose one optical interface. Table 3-27 and Table 3-28 provide SFP module information and specifications.

Table 3-27 SFP Module Options

SFP Module Product Number	SFP Module	Description
SFP-GE-S	Short wavelength (1000BASE-SX)	Contains a Class 1 laser of 850 nm for 1000BASE-SX (short wavelength) applications.
SFP-GE-L	Long wavelength/long haul (1000BASE-LX/LH)	Contains a Class 1 laser of 1310 nm for 1000BASE-LX/LH (long wavelength) applications.
SFP-GE-Z	Extended wavelength (1000BASE-ZX)	Contains a Class 1 laser of 1550 nm for 1000BASE-ZX (extended wavelength) applications.
SFP-GE-T	RJ-45 copper SFP module (1000BASE-T)	Provides full-duplex Gigabit Ethernet connectivity to high-end workstations and between wiring closets over an existing copper network infrastructure.

Table 3-28 SFP Module Specifications

Specification	Description
Wavelength	SFP-GE-S: 770 to 860 nm SFP-GE-L: 1270 to 1355 nm SFP-GE-Z: 1500 to 1580 nm SFP-GE-T: N/A.
Cabling distance (maximum)	SFP-GE-S: 500 m on 50/125um MMF; 300 m on 62.5/125um MMF SFP-GE-L: 6.2 miles (10 km) SFP-GE-Z: 49.7 miles (80 km) SFP-GE-T: 328 ft. (100 m)
Operating case temperature range	SFP-GE-S: 23 to 185 degrees F (–5 to 85 degrees C) SFP-GE-L: 23 to 185 degrees F (–5 to 85 degrees C) SFP-GE-Z: 23 to 185 degrees F (–5 to 85 degrees C)
Storage temperature range	SFP-GE-S: –40 to 185 degrees F (–40 to 85 degrees C) SFP-GE-L: –40 to 185 degrees F (–40 to 85 degrees C) SFP-GE-Z: –40 to 185 degrees F (–40 to 85 degrees C)
Supply voltage range	SFP-GE-S: 3.1 to 3.5 V SFP-GE-L: 3.1 to 3.5 V SFP-GE-Z: 3.1 to 3.5 V

SFP-GE-S Modules

The 1000BASE-SX (short wavelength) module operates on standard multimode fiber-optic link spans of up to 500 m on 50/125 um MMF and 300 m on 62.5/125 um MMF.

SFP-GE-L Modules

The 1000BASE-LX/LH (long wavelength/long haul) module interfaces fully comply with the IEEE 802.3z 1000BASE-LX standard. However, their higher optical quality allows them to reach 6.2 miles (10 km) over single-mode fiber (SMF) versus the 3.1 miles (5 km) specified in the standard.

SFP-GE-Z Modules

The 1000BASE-ZX (extended wavelength) module operates on ordinary single-mode fiber-optic link spans of up to 49.7 miles (80 km). Link spans of up to 62.1 miles (100 km) are possible using premium single-mode fiber or dispersion-shifted single-mode fiber (premium single-mode fiber has a lower attenuation per unit length than ordinary single-mode fiber; dispersion-shifted single-mode fiber has both lower attenuation and less dispersion).

The 1000BASE-ZX module must be coupled to single-mode fiber-optic cable, which is the type of cable typically used in long-haul telecommunications applications. The 1000BASE-ZX module will not operate correctly when coupled to multimode fiber, and it is not intended to be used in environments where multimode fiber is frequently used (for example, building backbones or horizontal cabling).

The 1000BASE-ZX module is intended to be used as a Physical Medium Dependent (PMD) component for Gigabit Ethernet interfaces found on various switch and router products. It operates at a signaling rate of 1250 Mbaud, transmitting and receiving 8B/10B encoded data.

When shorter lengths of single-mode fiber are used, it may be necessary to insert an in-line optical attenuator in the link to avoid overloading the receiver.

- Insert a 10-dB in-line optical attenuator between the fiber-optic cable plant and the receiving port on the 1000BASE-ZX module at each end of the link whenever the fiber-optic cable span is less than 15.5 miles (25 km).
- Insert a 5-dB in-line optical attenuator between the fiber-optic cable plant and the receiving port on the 1000BASE-ZX module at each end of the link whenever the fiber-optic cable span is equal to or greater than 15.5 miles (25 km) but less than 31 miles (50 km).

SFP-GE-T Modules

The SFP-GE-T (1000BASE-T copper SFP module) provides full-duplex Gigabit Ethernet connectivity to high-end workstations and between wiring closets over an existing copper network infrastructure. The SFP-GE-T maximum cabling distance is 328 feet (100 m).

SFP Module Cabling and Connection Equipment

Table 3-29 provides cabling specifications for the SFP modules that can be installed on the 2-Port Gigabit Ethernet SPA. Note that all SFP ports have LC-type connectors.

The minimum cable distance for the SFP-GE-S is 6.5 feet (2 m), and the minimum link distance for the SFP-GE-Z is 6.2 miles (10 km) with an 8-dB attenuator installed at each end of the link. Without attenuators, the minimum link distance for the SFP-GE-Z is 24.9 miles (40 km).

Table 3-29 SFP Module Port Cabling Specifications

SFP Modules	Wavelength (nm)	Fiber Type	Core Size (micron)	Modal Bandwidth (MHz/km)	Maximum Cable Distance
SFP-GE-S	850	MMF[1]	62.5	160	722 ft (220 m)
			62.5	200	984 ft (300 m)
			50.0	400	1640 ft (500 m)
			50.0	500	1804 ft (550 m)
SFP-GE-L	1300	MMF[2] and SMF	62.5	500	1804 ft (550 m)
			50.0	400	1804 ft (550 m)
			50.0	500	1804 ft (550 m)
			9/10	—	6.2 miles (10 km)
SFP-GE-Z	1550	SMF	9/10	—	49.7 miles (80 km)
		SMF[3]	8	—	62.1 miles (100 km)
SFP-GE-T	N/A	Copper	N/A	N/A	328 ft. (100 m)

1. Multimode fiber (MMF) only.
2. A mode-conditioning patch cord is required.
   When using the SFP-GE-L with 62.5-micron diameter MMF, you must install a mode-conditioning patch cord between the SFP module and the MMF cable on both the transmit and the receive ends of the link when link distances are greater than 984 ft (300 m).
   We do not recommend using the SFP-GE-L and MMF with no patch cord for very short link distance (tens of meters). The result could be an elevated bit error rate (BER).
3. Dispersion-shifted single-mode fiber-optic cable.

Note The 1000BASE-ZX SFP modules provide an optical power budget of 21.5 dB. You should measure your cable plant with an optical loss test set to verify that the optical loss of the cable plant (including connectors and splices) is less than or equal to 21.5 dB. The optical loss measurement must be performed with a 1550-nm light source.

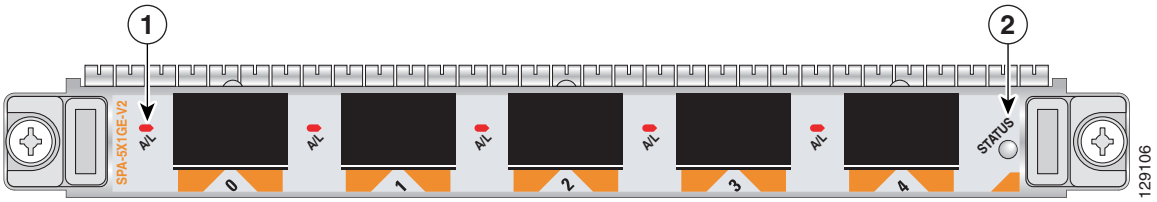
5-Port Gigabit Ethernet SPA Overview

The following sections describe the 5-Port Gigabit Ethernet SPA:

5-Port Gigabit Ethernet SPA LEDs

The 5-Port Gigabit Ethernet SPA has two types of LEDs: an A/L LED for each individual port and a STATUS LED for the SPA, as shown in Figure 3-40.

Figure 3-40 5-Port Gigabit Ethernet SPA Faceplate



1	A/L (Active/Link) LED	**2**	STATUS LED

Table 3-30 describes the 5-Port Gigabit Ethernet SPA LEDs.

Table 3-30 5-Port Gigabit Ethernet SPA LEDs

LED Label	Color	State	Meaning
A/L	Off	Off	Port is not enabled.
	Green	On	Port is enabled and the link is up.
	Amber	On	Port is enabled and the link is down.
STATUS	Off	Off	SPA power is off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and the SPA is being configured.

5-Port Gigabit Ethernet SPA Cables and Connectors

The 5-Port Gigabit Ethernet SPA has five electrical connectors that support SFP modules. Each port can send and receive traffic using cabling appropriate for the SFP module inserted.

SFP Module Connections

The small form-factor pluggable (SFP) module is an input/output (I/O) device that plugs into the Gigabit Ethernet ports on the 5-Port Gigabit Ethernet SPA, linking the port with a fiber-optic network.

Note The 5-Port Gigabit Ethernet SPA accepts only the SFP modules listed as supported in this document. An SFP module check is run every time an SFP module is inserted into the 5-Port Gigabit Ethernet SPA, and only SFP modules that pass this check can be used by the 5-Port Gigabit Ethernet SPA.
SFP modules exist for technologies other than Gigabit Ethernet and for products other than the 5-Port Gigabit Ethernet SPA. However, the information in this document pertains only to SFP modules that plug into the 5-Port Gigabit Ethernet SPA ports.

The SFP module has a receiver port (RX) and a transmitter port (TX) that compose one optical interface. Table 3-31 and Table 3-32 provide SFP module information and specifications.

Table 3-31 SFP Module Options

SFP Module Product Number	SFP Module	Description
SFP-GE-S	Short wavelength (1000BASE-SX)	Contains a Class 1 laser of 850 nm for 1000BASE-SX (short-wavelength) applications.
SFP-GE-L	Long wavelength/long haul (1000BASE-LX/LH)	Contains a Class 1 laser of 1310 nm for 1000BASE-LX/LH (long-wavelength) applications.
SFP-GE-Z	Extended wavelength (1000BASE-ZX)	Contains a Class 1 laser of 1550 nm for 1000BASE-ZX (extended-wavelength) applications.

Table 3-32 SFP Module Specifications

Specification	Description
Wavelength	SFP-GE-S: 770 to 860 nm SFP-GE-L: 1270 to 1355 nm SFP-GE-Z: 1500 to 1580 nm
Cabling distance (maximum)	SFP-GE-S: 500 m on 50/125um MMF; 300 m on 62.5/125um MMF SFP-GE-L: 6.2 miles (10 km) SFP-GE-Z: 49.7 miles (80 km)
Operating case temperature range	SFP-GE-S: 23 to 185 degrees F (–5 to 85 degrees C) SFP-GE-L: 23 to 185 degrees F (–5 to 85 degrees C) SFP-GE-Z: 23 to 185 degrees F (–5 to 85 degrees C)
Storage temperature range	SFP-GE-S: –40 to 185 degrees F (–40 to 85 degrees C) SFP-GE-L: –40 to 185 degrees F (–40 to 85 degrees C) SFP-GE-Z: –40 to 185 degrees F (–40 to 85 degrees C)
Supply voltage range	SFP-GE-S: 3.1 to 3.5 V SFP-GE-L: 3.1 to 3.5 V SFP-GE-Z: 3.1 to 3.5 V

SFP-GE-S Modules

The 1000BASE-SX (short-wavelength) module operates on standard multimode fiber-optic link spans of up to 500 m on 50/125um multimode fiber (MMF) and 300 m on 62.5/125um MMF.

SFP-GE-L Modules

The 1000BASE-LX/LH (long-wavelength/long-haul) module interfaces fully comply with the IEEE 802.3z 1000BASE-LX standard. However, their higher optical quality allows them to reach 6.2 miles (10 km) over single-mode fiber (SMF) versus the 3.1 miles (5 km) specified in the standard.

SFP-GE-Z Modules

The 1000BASE-ZX (extended wavelength) module operates on ordinary single-mode fiber-optic link spans of up to 49.7 miles (80 km). Link spans of up to 62.1 miles (100 km) are possible using premium single-mode fiber or dispersion-shifted single-mode fiber. (Premium single-mode fiber has a lower attenuation per unit length than ordinary single-mode fiber; dispersion-shifted single-mode fiber has both lower attenuation and less dispersion.)

The 1000BASE-ZX module must be coupled to single-mode fiber-optic cable, which is the type of cable typically used in long-haul telecommunications applications. The 1000BASE-ZX module does not operate correctly when coupled to multimode fiber, and it is not intended to be used in environments in which multimode fiber is frequently used (for example, building backbones or horizontal cabling).

The 1000BASE-ZX module is intended to be used as a Physical Medium Dependent (PMD) component for Gigabit Ethernet interfaces found on various switch and router products. It operates at a signaling rate of 1250 Mbaud, transmitting and receiving 8B/10B encoded data.

When shorter lengths of single-mode fiber are used, it may be necessary to insert an inline optical attenuator in the link to avoid overloading the receiver. Use the following guidelines:

- Insert a 10-dB inline optical attenuator between the fiber-optic cable plant and the receiving port on the 1000BASE-ZX module at each end of the link whenever the fiber-optic cable span is less than 15.5 miles (25 km).
- Insert a 5-dB inline optical attenuator between the fiber-optic cable plant and the receiving port on the 1000BASE-ZX module at each end of the link whenever the fiber-optic cable span is equal to or greater than 15.5 miles (25 km) but less than 31 miles (50 km).

SFP Module Cabling and Connection Equipment

Table 3-33 provides cabling specifications for the SFP modules that can be installed on the 5-Port Gigabit Ethernet SPA. Note that all SFP ports have LC-type connectors.

The minimum cable distance for the SFP-GE-S is 6.5 feet (2 m), and the minimum link distance for the SFP-GE-Z is 6.2 miles (10 km) with an 8-dB attenuator installed at each end of the link. Without attenuators, the minimum link distance for the SFP-GE-Z is 24.9 miles (40 km).

Table 3-33 SFP Module Port Cabling Specifications

SFP Modules	Wavelength (nm)	Fiber Type	Core Size (micron)	Modal Bandwidth (MHz/km)	Maximum Cable Distance
SFP-GE-S	850	MMF[1]	62.5	160	722 ft (220 m)
			62.5	200	984 ft (300 m)
			50.0	400	1640 ft (500 m)
			50.0	500	1804 ft (550 m)
SFP-GE-L	1300	MMF[2] and SMF	62.5	500	1804 ft (550 m)
			50.0	400	1804 ft (550 m)
			50.0	500	1804 ft (550 m)
			9/10	—	6.2 miles (10 km)

Table 3-33 SFP Module Port Cabling Specifications (continued)

SFP Modules	Wavelength (nm)	Fiber Type	Core Size (micron)	Modal Bandwidth (MHz/km)	Maximum Cable Distance
SFP-GE-Z	1550	SMF	9/10	—	49.7 miles (80 km)
		SMF[3]	8	—	62.1 miles (100 km)

1. Multimode fiber (MMF) only.
2. A mode-conditioning patch cord is required.
   When using the SFP-GE-L with 62.5-micron diameter MMF, you must install a mode-conditioning patch cord between the SFP module and the MMF cable on both the transmit and the receive ends of the link when link distances are greater than 984 ft (300 m).
   We do not recommend using the SFP-GE-L and MMF with no patch cord for very short link distance (tens of meters). The result could be an elevated bit error rate (BER).
3. Dispersion-shifted single-mode fiber-optic cable.

Note The 1000BASE-ZX SFP modules provide an optical power budget of 21.5 dB. You should measure your cable plant with an optical loss test set to verify that the optical loss of the cable plant (including connectors and splices) is less than or equal to 21.5 dB. The optical loss measurement must be performed with a 1550-nm light source.

10-Port Gigabit Ethernet SPA Overview

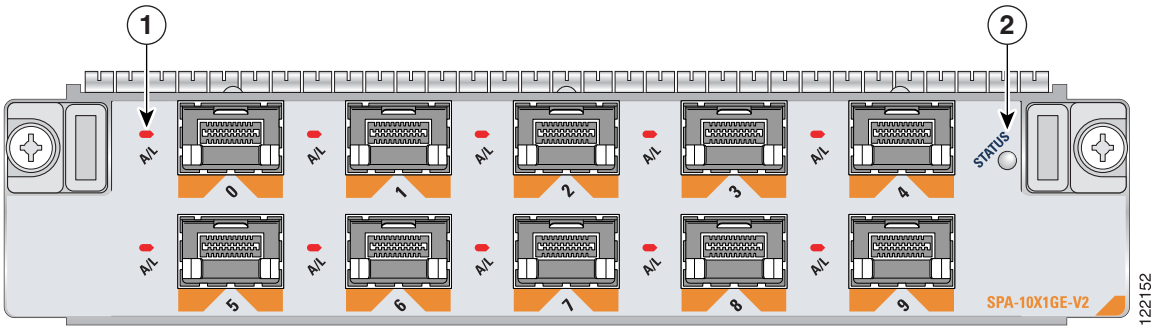
The following sections describe the 10-Port Gigabit Ethernet SPA:

- 10-Port Gigabit Ethernet SPA LEDs, page 3-54
- 10-Port Gigabit Ethernet SPA Cables and Connectors, page 3-54

10-Port Gigabit Ethernet SPA LEDs

The 10-Port Gigabit Ethernet SPA has two types of LEDs: an A/L LED for each individual port and a STATUS LED for the SPA, as shown in Figure 3-41.

Figure 3-41 10-Port Gigabit Ethernet SPA Faceplate



1	A/L (Active/Link) LED	**2**	STATUS LED

Table 3-34 describes the 10-Port Gigabit Ethernet SPA LEDs.

Table 3-34 10-Port Gigabit Ethernet SPA LEDs

LED Label	Color	State	Meaning
A/L	Off	Off	Port is not enabled.
	Green	On	Port is enabled and the link is up.
	Amber	On	Port is enabled and the link is down.
STATUS	Off	Off	SPA power is off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and the SPA is being configured.

10-Port Gigabit Ethernet SPA Cables and Connectors

The 10-Port Gigabit Ethernet SPA has ten electrical connectors that support SFP modules. Each port can send and receive traffic using cabling appropriate for the SFP module inserted.

SFP Module Connections

The small form-factor pluggable (SFP) module is an input/output (I/O) device that plugs into the Gigabit Ethernet optical slots on the 10-Port Gigabit Ethernet SPA, linking the port with a 1000BASE-X fiber-optic network.

Note The 10-Port Gigabit Ethernet SPA accepts only the SFP modules listed as supported in this document. An SFP module check is run every time an SFP is inserted into the 10-Port Gigabit Ethernet SPA, and only SFP modules that pass this check can be used by the 10-Port Gigabit Ethernet SPA.
SFP modules exist for technologies other than Gigabit Ethernet and for products other than the 10-Port Gigabit Ethernet SPA. However, the information in this document pertains only to SFP modules that plug into the 10-Port Gigabit Ethernet SPA ports.

The SFP module has a receiver port (RX) and a transmitter port (TX) that compose one optical interface. Table 3-35 and Table 3-36 provide SFP information and specifications.

Table 3-35 10-Port Gigabit Ethernet SFP Module Options

SFP Module Product Number	SFP Module	Description
SFP-GE-S	Short wavelength (1000BASE-SX)	Contains a Class 1 laser of 850 nm for 1000BASE-SX (short-wavelength) applications.
SFP-GE-L	Long wavelength/long haul (1000BASE-LX/LH)	Contains a Class 1 laser of 1310 nm for 1000BASE-LX/LH (long-wavelength) applications.
SFP-GE-Z	Extended wavelength (1000BASE-ZX)	Contains a Class 1 laser of 1550 nm for 1000BASE-ZX (extended-wavelength) applications.

Table 3-36 10-Port Gigabit Ethernet SFP Module Specifications

Specification	Description
Wavelength	SFP-GE-S: 770 to 860 nm SFP-GE-L: 1270 to 1355 nm SFP-GE-Z: 1500 to 1580 nm
Cabling distance (maximum)	SFP-GE-S: 500 m on 50/125um MMF; 300 m on 62.5/125um MMF SFP-GE-L: 6.2 miles (10 km) SFP-GE-Z: 49.7 miles (80 km)
Operating case temperature range	SFP-GE-S: 23 to 185 degrees F (–5 to 85 degrees C) SFP-GE-L: 23 to 185 degrees F (–5 to 85 degrees C) SFP-GE-Z: 23 to 185 degrees F (–5 to 85 degrees C)
Storage temperature range	SFP-GE-S: –40 to 185 degrees F (–40 to 85 degrees C) SFP-GE-L: –40 to 185 degrees F (–40 to 85 degrees C) SFP-GE-Z: –40 to 185 degrees F (–40 to 85 degrees C)
Supply voltage range	SFP-GE-S: 3.1 to 3.5 V SFP-GE-L: 3.1 to 3.5 V SFP-GE-Z: 3.1 to 3.5 V

SFP-GE-S Modules

The 1000BASE-SX (short-wavelength) module operates on standard multimode fiber-optic link spans of up to 500 m on 50/125 um multimode fiber (MMF) and 300 m on 62.5/125 um MMF.

SFP-GE-L Modules

The 1000BASE-LX/LH (long-wavelength/long-haul) module interfaces fully comply with the IEEE 802.3z 1000BASE-LX standard. However, their higher optical quality allows them to reach 6.2 miles (10 km) over single-mode fiber (SMF) versus the 3.1 miles (5 km) specified in the standard.

SFP-GE-Z Modules

The 1000BASE-ZX (extended-wavelength) module operates on ordinary single-mode fiber-optic link spans of up to 49.7 miles (80 km). Link spans of up to 62.1 miles (100 km) are possible using premium single-mode fiber or dispersion-shifted single-mode fiber. (Premium single-mode fiber has a lower attenuation per unit length than ordinary single-mode fiber; dispersion-shifted single-mode fiber has both lower attenuation and less dispersion.)

The 1000BASE-ZX module must be coupled to single-mode fiber-optic cable, which is the type of cable typically used in long-haul telecommunications applications. The 1000BASE-ZX module does not operate correctly when coupled to multimode fiber, and it is not intended to be used in environments in which multimode fiber is frequently used (for example, building backbones or horizontal cabling).

The 1000BASE-ZX module is intended to be used as a Physical Medium Dependent (PMD) component for Gigabit Ethernet interfaces found on various switch and router products. It operates at a signaling rate of 1250 Mbaud, transmitting and receiving 8B/10B encoded data.

When shorter lengths of single-mode fiber are used, it may be necessary to insert an inline optical attenuator in the link to avoid overloading the receiver. Use the following guidelines:

- Insert a 10-dB inline optical attenuator between the fiber-optic cable plant and the receiving port on the 1000BASE-ZX module at each end of the link whenever the fiber-optic cable span is less than 15.5 miles (25 km).
- Insert a 5-dB inline optical attenuator between the fiber-optic cable plant and the receiving port on the 1000BASE-ZX module at each end of the link whenever the fiber-optic cable span is equal to or greater than 15.5 miles (25 km) but less than 31 miles (50 km).

SFP Module Cabling and Connection Equipment

Table 3-37 provides cabling specifications for the SFP modules that can be installed on the 10-Port Gigabit Ethernet SPA. Note that all SFP ports have LC-type connectors.

The minimum cable distance for the SFP-GE-S is 6.5 feet (2 m), and the minimum link distance for the SFP-GE-Z is 6.2 miles (10 km) with an 8-dB attenuator installed at each end of the link. Without attenuators, the minimum link distance for the SFP-GE-Z is 24.9 miles (40 km).

Table 3-37 SFP Module Port Cabling Specifications

SFP Modules	Wavelength (nm)	Fiber Type	Core Size (micron)	Modal Bandwidth (MHz/km)	Maximum Cable Distance
SFP-GE-S	850	MMF[1]	62.5	160	722 ft (220 m)
			62.5	200	984 ft (300 m)
			50.0	400	1640 ft (500 m)
			50.0	500	1804 ft (550 m)
SFP-GE-L	1300	SMF	9/10	—	6.2 miles (10 km)

Table 3-37 SFP Module Port Cabling Specifications (continued)

SFP Modules	Wavelength (nm)	Fiber Type	Core Size (micron)	Modal Bandwidth (MHz/km)	Maximum Cable Distance
SFP-GE-Z	1550	SMF	9/10	—	49.7 miles (80 km)
		SMF[2]	8	—	62.1 miles (100 km)

1. Multimode fiber (MMF) only.
2. Dispersion-shifted single-mode fiber-optic cable.

Note The 1000BASE-ZX SFP modules provide an optical power budget of 21.5 dB. You should measure your cable plant with an optical loss test set to verify that the optical loss of the cable plant (including connectors and splices) is less than or equal to 21.5 dB. The optical loss measurement must be performed with a 1550-nm light source.

IPSec VPN SPA Overview

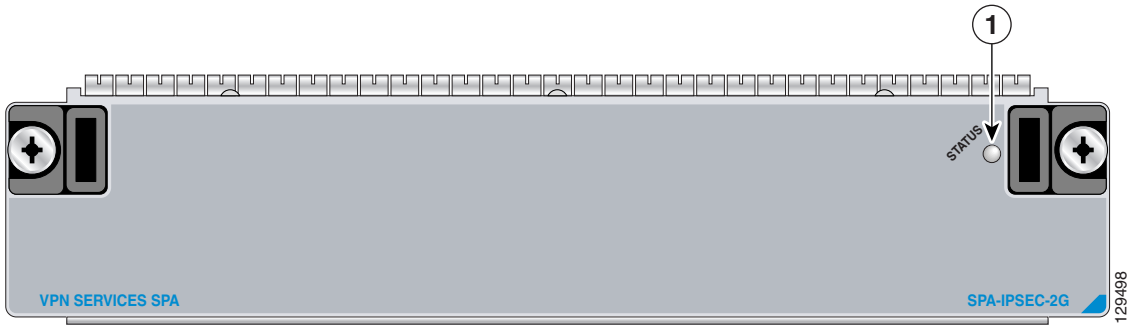
The following sections describe the IPSec VPN SPA:

- IPSec VPN SPA LEDs, page 3-57

IPSec VPN SPA LEDs

The IPSec VPN SPA has one LED, as shown in Figure 3-42.

Figure 3-42 IPSec VPN SPA Faceplate



1	STATUS LED		

Table 3-38 describes the IPSec VPN SPA LED.

Table 3-38 IPSec VPN SPA LED

LED Label	Color	State	Meaning
STATUS	Off	Off	SPA power is off.
	Amber	On	SPA power is on and the SPA is being configured.
	Green	On	SPA is ready and operational.