



# Overview: Cisco ASR 9000 Series Router Shared Port Adapters

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This chapter describes the shared port adapters (SPAs) that are supported on the Cisco ASR 9000 Series Aggregation Services Router and contains the following sections:

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## SPA Summary

The following table shows the summary descriptions of the SPAs that are supported on the Cisco ASR 9000 Series Aggregation Services Router.

Table 1: Supported SPAs on Cisco ASR 9000 Series Aggregation Services Routers

Product Number	Description	Number and Type of Ports	Minimum Cisco IOS XR Release	Minimum Hardware Revision
SPA-2XCHOC12/DS0	2-Port Channelized OC-12/DS0 SPA double-height	2 OC12	3.9.0	1.0
SPA-1XCHOC48/DS3	1-Port Channelized OC48/STM16 DS3 SPA double-height	1 OC48	4.0.0	1.0
SPA-2XOC48POS/RPR	2-Port OC-48/STM16 SPA double-height	2 OC48	4.0.0	1.0
SPA-8XOC12-POS	8-Port OC12/STM4 SPA single-height	8 OC12	4.0.0	1.0
SPA-OC192POS-XFP	1-Port OC-192/STM-64 POS/RPR SPA single-height	1 OC192	4.0.0	1.0
SPA-2XT3E3 SPA-4XT3E3	2-Port and 4-Port Clear Channel T3/E3 SPA single-height	2 or 4 T3/E3	4.0.1	1.0
SPA-4XCT3/DS0	4-Port Channelized T3 to DS0 single-height	4 T3	4.1.0	1.0
SPA-8XCHT1/E1	8-Port Channelized T1/E1 SPA single-height	8 T1/E1	4.1.0	1.0
SPA-1XCHSTM1/OC3	1-Port Channelized OC-3/STM-1 SPA single-height	1 OC3	4.0.1	1.0
SPA-4XOC3-POS-V2	4-Port OC-3/STM-1 POS SPA single-height	4 OC3	4.0.1	1.0
SPA-8XOC3-POS	8-Port OC-3/STM-1 POS SPA single-height	8 OC3	4.0.1	1.0
SPA-1CHOC3-CE-ATM	1-Port Channelized OC-3 ATM CEoP SPA single-height	1 OC3	4.2.0	1.0
SPA-1XOC3-ATM-V2 SPA-3XOC3-ATM-V2	1-Port and 3-Port Clear Channel OC-3 ATM SPA single-height	1 or 3 OC3	4.2.0	1.0

Product Number	Description	Number and Type of Ports	Minimum Cisco IOS XR Release	Minimum Hardware Revision
SPA-1XOC12-ATM-V2	1-Port Clear Channel OC-12 ATM SPA single-height	1 OC12	4.2.0	1.0
SPA-2XOC12-POS	2-Port OC-3 STM-1/OC-12 STM-4 POS SPA single-height	2 OC12	4.3.0	1.0
SPA-4XOC12-POS	4-Port OC-3 STM-1/OC-12 STM-4 POS SPA single-height	4 OC12	4.3.0	1.0
SPA-4XOC48POS/RPR	4-Port OC-48/STM-16 POS/RPR SPA double-height	4 OC48	4.3.0	1.0
SPA-2CHT3-CE-ATM	2-Port Channelized T3/E3 ATM CEoP SPA single-height	2 T3/E3	4.3.0	1.0
SPA-24CHT1-CE-ATM	24-Port Channelized T1/E1/J1 CEoP SPA single-height	24 T1/E1	4.3.0	1.0
SPA-8XCHT1/E1-V2	8-Port Channelized T1/E1 SPA single-height	8 T1/E1	5.1.1	1.0
SPA-1XOC48POS/RPR	1-Port OC-48/STM16 SPA single-height	1 OC48	5.1.1	1.0
			6.3.1	2.0

## Checking Hardware and Software Compatibility

To check the minimum software requirements of Cisco IOS XR 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 XR 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.

## 2-Port Channelized OC-12/DS0 SPA Overview

The 2-Port Channelized OC-12/DS0 SPA is a double-height SPA that provides Synchronous Optical Network (SONET) network connectivity with a bandwidth of 622.08 Mbps.

The following sections describe the 2-Port Channelized OC-12/DS0 SPA:

### 2-Port Channelized OC-12/DS0 SPA LEDs

The 2-Port Channelized OC-12/DS0 SPA has three types of LEDs. There are two LEDs for each port on the SPA, and one STATUS LED. The following figure shows an example of these LEDs on a SPA.

**Figure 1: 2-Port Channelized OC-12/DS0 SPA Faceplate**



1	CAR (Carrier/Alarm) LED	3	STATUS LED
2	ACT (Active Loopback) LED		

The following table describes the 2-Port Channelized OC-12/DS0 SPA LEDs.

**Table 2: 2-Port Channelized OC-12/DS0 SPA LEDs**

LED Label	Color	State	Meaning
CAR	Off	Off	Port is not enabled by software.
CAR and ACT LEDs are per port.	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.
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 STATUS LED is per SPA.	Off	Off	SPA power is off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and SPA is being configured.

## 2-Port Channelized OC-12/DS0 SPA Interface Specifications

The framer processes incoming and outgoing SONET 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 mapped into the STS-12c/STM-4 frame. The main operational mode of the framer is OC-12, where each one of the 12 Paths can carry a DS3 and each DS3 can carry 28 DS1s.

The 2-Port Channelized OC-12/DS0 SPA interface is compliant with ANSI and Telco standards.

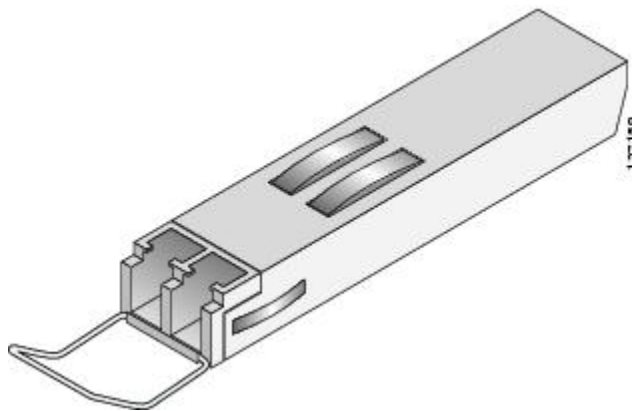
## 2-Port Channelized OC-12/DS0 SPA SFP Optical Transceiver Modules and Cables

The 2-Port Channelized OC-12/DS0 SPA uses a small form-factor pluggable (SFP) optical transceiver module installed in each port for SONET single-mode and multimode optical fiber connection. (See the following figure.)

Cisco Systems qualifies the optics that are approved for use with its SPAs. The 2-Port Channelized OC-12/DS0 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 2: SFP Optics Module*



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

- Multimode—622.08-Mbps, OC-12 optical fiber (SONET STS-12c)

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)

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

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 2-Port Channelized OC-12/DS0 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.

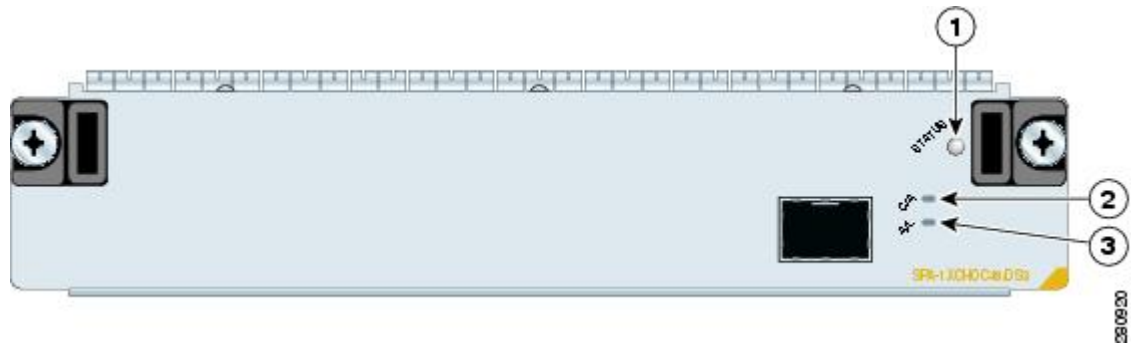
## 1-Port Channelized STM-16/OC-48 SPA Overview

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

### 1-Port Channelized STM-16/OC-48 SPA LEDs

The 1-Port Channelized STM-16/OC-48 SPA has two types of LEDs: an A/L LED for the port and a STATUS LED, as shown in the following figure.

**Figure 3: 1-Port Channelized STM-16/OC-48 SPA Faceplate**



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

The 1-Port Channelized STM-16/OC-48 SPA LEDs are described in the following table.

**Table 3: 1-Port Channelized STM-16/OC-48 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.

LED Label	Color	State	Meaning
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and good, and SPA is being configured.

## 1-Port Channelized STM-16/OC-48 SPA Interface Specifications

The framer processes incoming and outgoing SONET or SDH frames. The framer operates at OC-48/STM-16 line rates (2.488 Gbps).

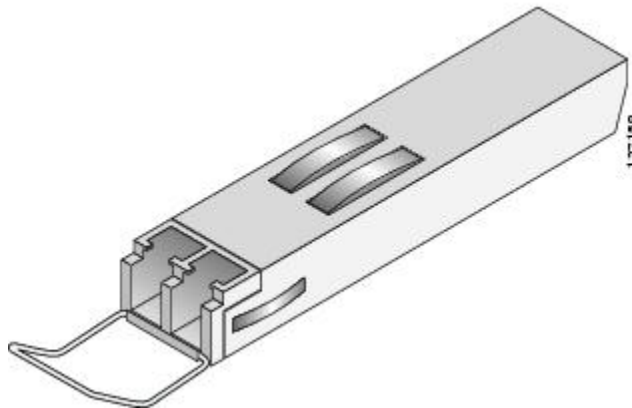
Packet data is transported with a user-configured encapsulation (such as Point-to-Point Protocol [PPP]) and is mapped into the STS-48/STM-16 frame. HDLC and Frame-Relay are also supported. The main operational mode of the framer is OC-48, where each one of the 48 Paths can carry a DS3 and each DS3 can carry 28 DS1s.

The 1-Port Channelized STM-16/OC-48 SPA interface is compliant with RFC 1619, *PPP over SONET/SDH*, and RFC 1662, *PPP in HDLC-like Framing*. The 1-Port Channelized STM-16/OC-48 SPA also provides support for SNMP v1 agent (RFC 1155–1157), and Management Information Base (MIB) II (RFC 1213).

## 1-Port Channelized STM-16/OC-48 SPA Cables and Connectors

The 1-Port Channelized STM-16/OC-48 SPA uses a small form-factor pluggable (SFP) optical transceiver module installed in the port for SONET and SDH single-mode and multimode optical fiber connection (see the following figure).

**Figure 4: SFP Optics Module**



The SFP optical transceiver modules used with the 1-Port Channelized STM-16/OC-48 SPA provide the following optical fiber options:

- Multimode—2.488-Gbps, OC-48/STM-16 optical fiber (SONET STS-48 or SDH STM-16)

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

- Single-mode—2.488-Gbps, OC-48/STM-16 optical fiber (SONET STS-48 or SDH STM-16)

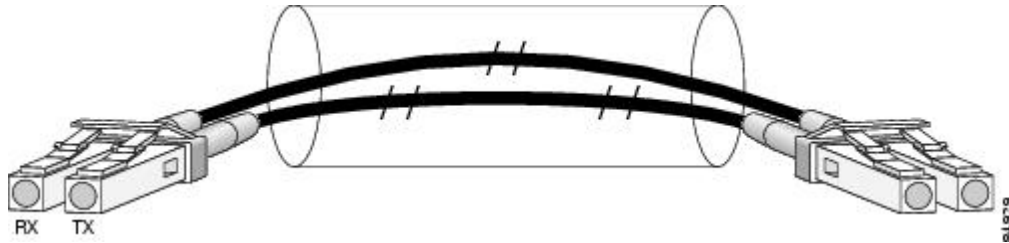
Use a single-mode optical fiber that has a modal-field diameter of  $8.7 \pm 0.5$  microns. (Nominal diameter is approximately 10/125 microns.)

For single-mode and multimode optical fiber connections, you can use either a duplex LC-type cable (see the figure below) 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-16/OC-48 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 5: LC Type Cable



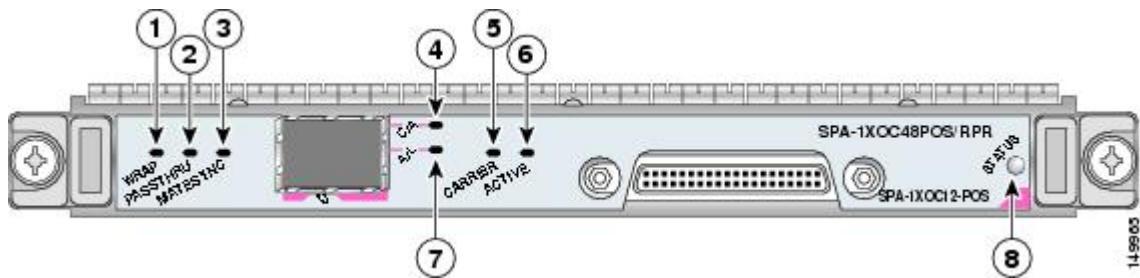
# 1-Port OC-48 POS RPR SPA Overview

The following sections describe the 1-Port OC48-POS/RPR SPA:

## 1-Port OC48-POS/RPR SPA LEDs

The 1-Port OC48-POS/RPR SPA has eight LEDs, as shown in the following figure.

Figure 6: 1-Port OC48-POS/RPR SPA Faceplate



1	WRAP	5	CARRIER LED
2	PASSTHROUGH LED	6	ACTIVE LED
3	MATESYNC LED	7	A/L (Active/Loopback) LED
4	CAR (Carrier/Alarm) LED	8	STATUS LED



**Note** The WRAP, PASSTHROUGH, and MATESYNC LEDs apply to the SPA in RPR/SRP mode only.



The 1-Port OC48-POS/RPR SPA LEDs are described in the following table.

**Table 4: 1-Port OC48-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-through mode.
	Amber	On	Port is in pass-through mode.
MATESYNC	Off	Off	Mate port is not synchronized.
	Green	On	Mate port is synchronized.
C/A	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software.
	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.
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 OC48-POS/RPR SPA Interface Specifications

The physical layer interface for the 1-Port OC48-POS/RPR SPA is Optical Carrier-48 (OC-48), and the 1-Port OC48-POS/RPR SPA is designed to comply with POS specifications. The 1-Port OC48-POS/RPR SPA provides one 2.488-Gbps network interface for all supported platforms.

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

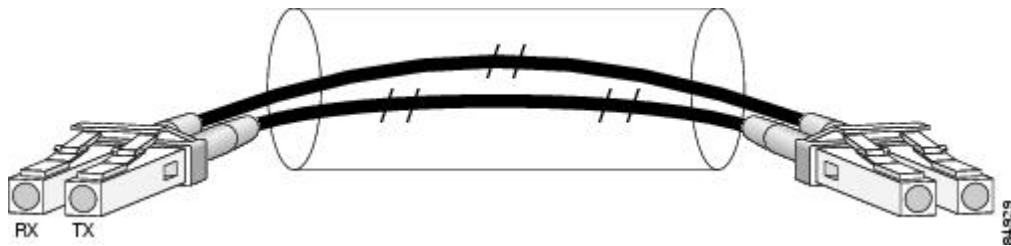
Use single-mode (for intermediate-configurations) optical fiber cable to connect your router to a network or to connect two OC-48-equipped routers back-to-back.

The 1-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

The 1-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 the below figure) or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

**Figure 7: Duplex Patch Cable with LC-Type Connectors**



**Note** The 40-pin connector on the 1-Port OC-48/STM-16 POS SPA is used for resilient packet ring (RPR) connections.

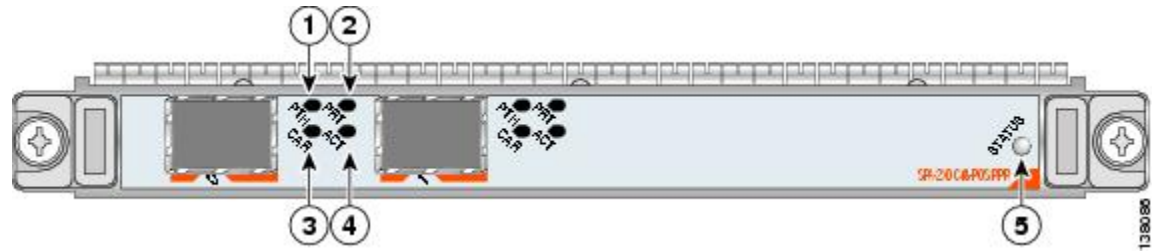
## 2-Port OC-48 POS RPR SPA Overview

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

### 2-Port OC48-POS/RPR SPA LEDs

The 2-Port OC48-POS/RPR SPA has five LEDs, as shown in the following figure.

Figure 8: 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		

The 2-Port OC48-POS/RPR SPA LEDs are described in the following table.

Table 5: 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

LED Label	Color	State	Meaning
	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

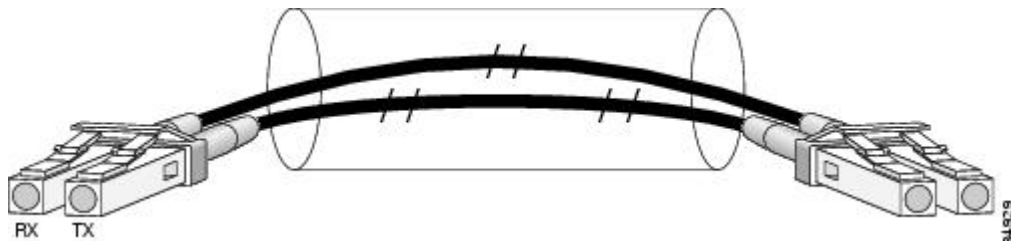
Use single-mode (for intermediate-configurations) optical fiber cable to connect your router to a network or to connect two OC-48-equipped routers back-to-back.

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 the below figure) or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

**Figure 9: Duplex Patch Cable with LC-Type Connectors**



## 8-Port OC-12 STM-4 POS SPA Overview

The 8-Port OC12/STM4 SPA is a single-height SPA that installs into one SIP subslot. The SPA with small form-factor pluggable (SFP) optical transceiver modules provides Optical Carrier Level (OC-*n*) for SONET and Synchronous Transport Module (STM-*n*) for SDH network connectivity. On this SPA, any given port can use an OC-12 SFP module, so the per-port bandwidth can be 622.08 Mbps.



**Note** When SFP modules are replaced, the SPA interface retains any previously defined configurations. These configurations include settings for IP address, clock source, loopback, CRC, and POS flags.

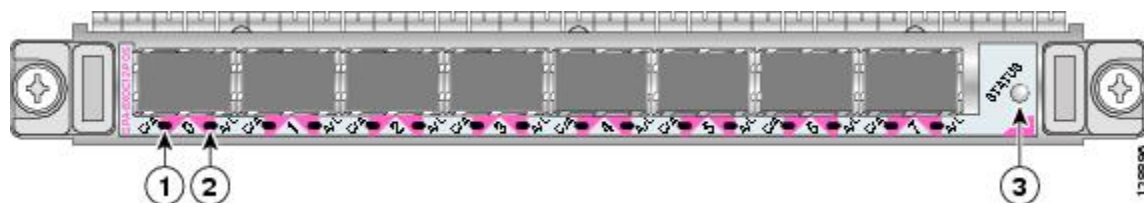
For more information about SPA bandwidth, see the “Bandwidth Oversubscription” topic in this chapter. For more information about SPAs and their compatibility with SIPs and modular optics, see the “SIP and SPA Product Overview” chapter in this guide.

The following sections describe the 8-Port OC-3 STM-1/OC-12 STM-4 POS SPA:

### 8-Port OC12/STM4 SPA LEDs

The 8-Port OC12/STM4 SPA has three types of LEDs: two LEDs for each port on the SPA and one STATUS LED. The following figure shows the 8-Port OC12/STM4 SPA faceplate.

Figure 10: 8-Port OC12/STM4 SPA Faceplate



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

The following table describes the 8-Port OC12/STM4 SPA LEDs.

Table 6: 8-Port OC12/STM4 SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	SONET controller is shut down.
	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.

LED Label	Color	State	Meaning
A/L	Off	Off	Interface is shut down.
	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 is off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and good, and the SPA is being configured.

## 8-Port OC12/STM4 SPA Interface Specifications

The framer processes incoming and outgoing SONET or SDH frames. The framer operates at OC-12 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 Layer 2 frame.

The 8-Port OC12/STM4 SPA interface complies with the following RFCs:

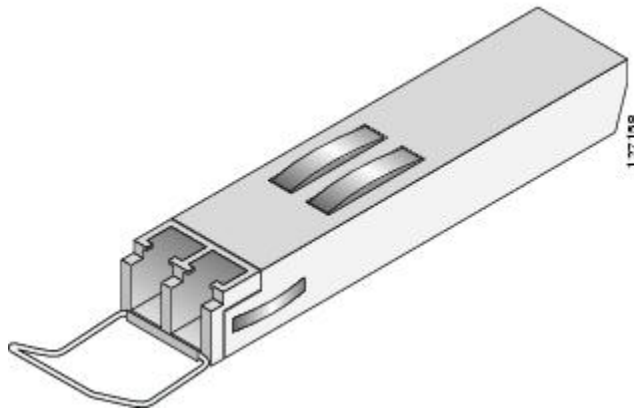
- RFC 1662, *PPP in HDLC-like Framing*
- RFC 2427, *Multiprotocol Interconnect over Frame Relay*
- RFC 2615, *PPP over SONET/SDH*

## 8-Port OC12/STM4 SPA Optical Transceiver Modules and Cables

The 8-Port OC12/STM4 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 connections (see the below figure).

Cisco Systems qualifies the optics that are approved for use with its SPAs. The following OC-12 optical transceiver modules are supported on the 8-Port OC12/STM4 SPA :

- 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
- Long-reach (LR) SFP module (80 km)—SFP-OC12-LR2

**Figure 11: SFP Optics Module**

The following OC-12 optical fiber options are available for the 8-Port OC-12c/STM-4 POS SPA:

- 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.

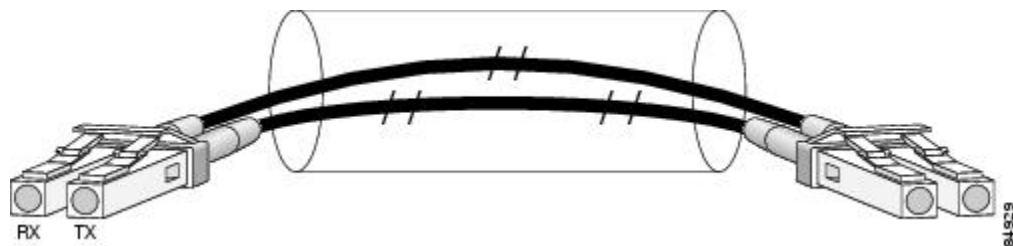
- Single-mode—622.08-Mbps, OC-12 optical fiber (SONET STS-12c or SDH STM-4)

Use a single-mode optical fiber that has a modal-field diameter of  $8.7 \pm 0.5$  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 the following figure) or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

Use single-mode (for short-, intermediate- or long-reach configurations) or multimode optical fiber cable to connect your router to a network or two OC-12-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 them.

**Figure 12: LC-Type Cable**

## OC-12 Module Connections

The following table shows the OC-12 specifications of the optics on the 8-Port OC-12c/STM-4 POS SPA.

Table 7: OC-12 Specifications

Specification	Description
Wavelength	OC-12 MM: 1270 nm to 1380 nm OC-12 SR: 1261 nm to 1360 nm OC-12 IR-1: 1293 nm to 1334 nm OC-12 LR-1: 1280 nm to 1335 nm OC-12 LR-2: 1480 nm to 1580 nm
Cabling distance (maximum)	OC-12 MM: 0.5 km (0.3 miles) OC-12 SR: 2 km (1.2 miles) OC-12 IR-1: 15 km (9.3 miles) OC-12 LR-1: 40 km (24.8 miles) OC-12 LR-2: 80 km (49.7 miles)
Operating case temperature range	OC-12 MM: 23 to 185 degrees F (–5 to 85 degrees C) OC-12 SR: 23 to 185 degrees F (–5 to 85 degrees C) OC-12 IR-1: 23 to 185 degrees F (–5 to 85 degrees C) OC-12 LR-1: 23 to 185 degrees F (–5 to 85 degrees C) OC-12 LR-2: 23 to 185 degrees F (–5 to 85 degrees C)
TX power	OC-12 MM: –20 to –14 dBm OC-12 SR: –15 to –8 dBm OC-12 IR-1: –15 to –8 dBm OC-12 LR-1: –3 to 2 dBm OC-12 LR-2: –3 to 2 dBm
Receiver sensitivity (maximum)	OC-12 MM: –26 dBm OC-12 SR: –23 dBm OC-12 IR-1: –28 dBm OC-12 LR-1: –28 dBm OC-12 LR-2: –28 dBm
RX overload	OC-12 MM: –6 dBm OC-12 SR: –8 dBm OC-12 IR-1: –8 dBm OC-12 LR-1: –8 dBm OC-12 LR-2: –8 dBm
Maximum receiver power damage	OC-12 MM: +5 dBm OC-12 SR: +5 dBm OC-12 IR-1: +5 dBm OC-12 LR-1: +5 dBm OC-12 LR-2: +5 dBm

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

The 1-Port OC-192/STM-64 POS/RPR XFP SPA is a single-height SPA that is installed in one SIP subslot. The 1-Port OC-192/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 in this chapter. For more information about SPAs and their compatibility with SIPs and modular optics, see the SIP overview chapter in this guide.

The 1-Port OC-192/STM-64 POS/RPR XFP SPA uses a 10-Gbps small form-factor pluggable optical receptacle for the port allowing connection to single-mode optical fiber. For more information on the optical fiber cables used with this SPA, see the [1-Port OC-192/STM-64 POS/RPR XFP SPA Optical Transceiver Modules, Connectors, and Cables](#), on page 18.

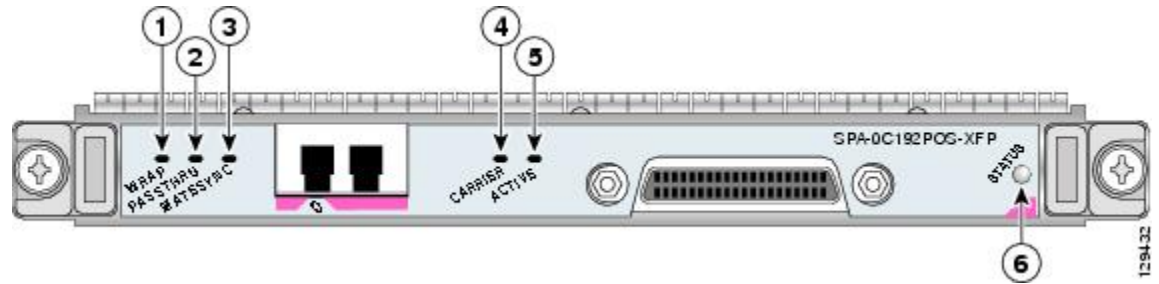
The following sections describe the 1-Port OC-192/STM-64 POS/RPR XFP SPA:

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

The 1-Port OC-192/STM-64 POS/RPR XFP SPA has six LEDs, as shown in the following figure.



Figure 13: 1-Port OC-192/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

The following table describes the 1-Port OC-192/STM-64 POS/RPR XFP SPA LEDs.

Table 8: 1-Port OC-192/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-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.

LED Label	Color	State	Meaning
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-192/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-192/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*



**Note** For Cisco IOS XR Software Release 3.8.0, the 1-Port OC-192c/STM-64 POS/RPR XFP SPA supports the Dynamic Packet Transport (DPT) feature. The Cisco DPT family of products delivers scalable Internet service, reliable IP-aware optical transport, and simplified network operations. The Spatial Reuse Protocol (SRP) is a MAC-layer protocol developed by Cisco and is used in conjunction with Cisco DPT products, which use a pair of counter-rotating rings in an optimum fashion to provide improved bandwidth utilization over an equivalent SONET network.

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

The 1-Port OC-192/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-192/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. The above-listed XFPs are the only optical transceiver modules qualified for use.

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

The following figure shows the cable type for use with the XFP optical transceiver module on the 1-Port OC-192/STM-64 POS/RPR XFP SPA.

Figure 14: LC-Type Cable for the XFP Optical Transceiver Modules



## OC-192 Module Connections

The following table shows the OC-192 specifications for use with the 1-Port OC-192/STM-64 POS/RPR XFP SPA.

Table 9: 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
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

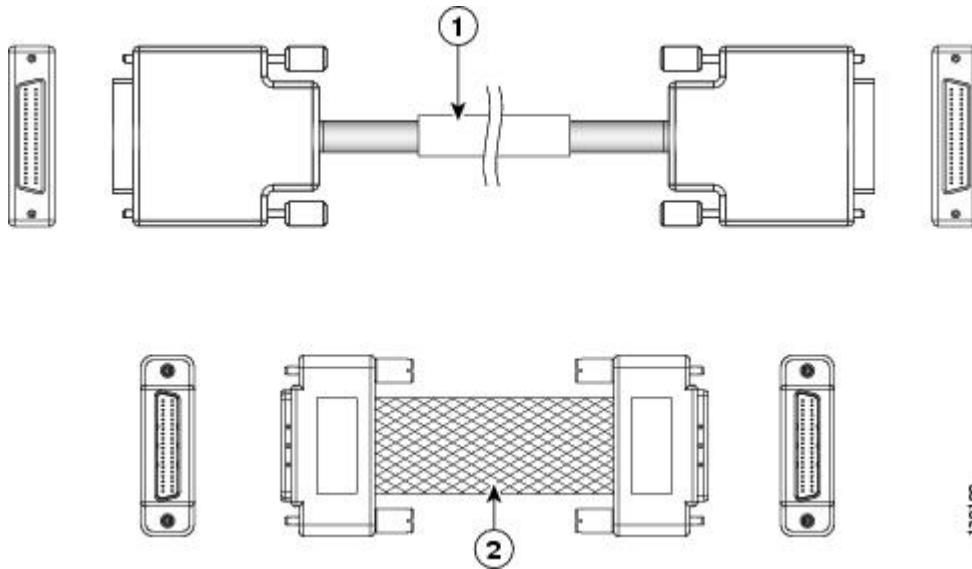
## Mate Interface Cables

The 1-Port OC-192/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-192/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. The following figure shows the mate cables used to connect the SPAs.

Figure 15: 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)
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**Note** The RPR mate cable is necessary only 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 support using SPA datasheets or by contacting your Cisco representative.

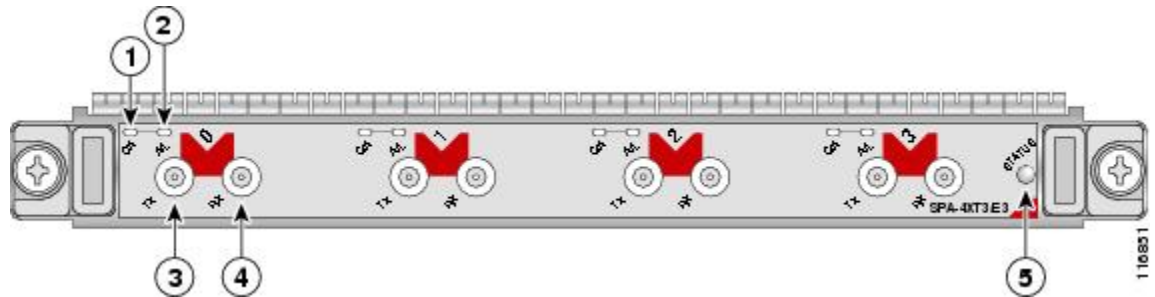
## 2-Port and 4-Port Clear Channel T3/E3 SPA Overview

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: two LEDs for each port on the SPA, and one STATUS LED, as shown in the following figure.

Figure 16: 2-Port and 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		

The following table describes the 2-Port and 4-Port Clear Channel T3/E3 SPA LEDs.

Table 10: 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, and loopback is off.
	Amber	On	Port is enabled by software, and 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 the SPA is being configured.

## 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 (44.736 /34.368 Mbps) depending on the mode in which it is configured.

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 connectors on one end and the Siemax connectors on the other. If similar SPAs are connected back-to-back, both ends of cable will be Siemax.

- 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).

The *2-Port and 4-Port Clear Channel T3/E3 SPA Faceplate* figure shows the connectors on the 2-Port and 4-Port Clear Channel T3/E3 SPA, and the following table describes the signal descriptions for these connectors.

**Table 11: 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.

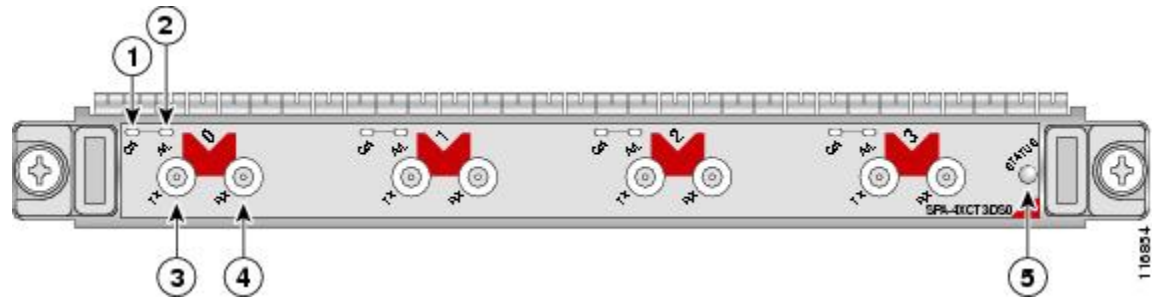
## 4-Port Channelized T3 to DS0 Overview

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

### 4-Port Channelized T3 to DS0 LEDs

The 4-Port Channelized T3 to DS0 has three types of LEDs. There are two LEDs for each port on the SPA, and one STATUS LED. The following figure shows an example of these LEDs on a 4-Port Channelized T3 to DS0.

Figure 17: 4-Port Channelized T3 to DS0 Faceplate



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

The 4-Port Channelized T3 to DS0 LEDs are described in the following table.

Table 12: 4-Port Channelized T3 to DS0 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.

## 4-Port Channelized T3 to DS0 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 4-Port Channelized T3 to DS0 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.



**Note** The 4-Port Channelized T3 to DS0 supports Frame Relay Fragmentation (FRF.12) and Multilink Frame Relay (MFR) features for Cisco IOS XR Software Release 3.6.0 and later releases.

## 4-Port Channelized T3 to DS0 Cables and Connectors

The interface connectors on the 4-Port Channelized T3 to DS0 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 4-Port Channelized T3 to DS0. The cables have BNC connectors on one end and the Siemax connectors on the other. If similar SPAs are connected back-to-back, both ends of the cable should have Siemax connectors.

- 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).

The previous figure shows the Siemax connectors on the 4-Port Channelized T3 to DS0, and the following table provides the signal descriptions for these connectors.

*Table 13: 4-Port Channelized T3 to DS0 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.

## 8-Port Channelized T1/E1 SPA Overview

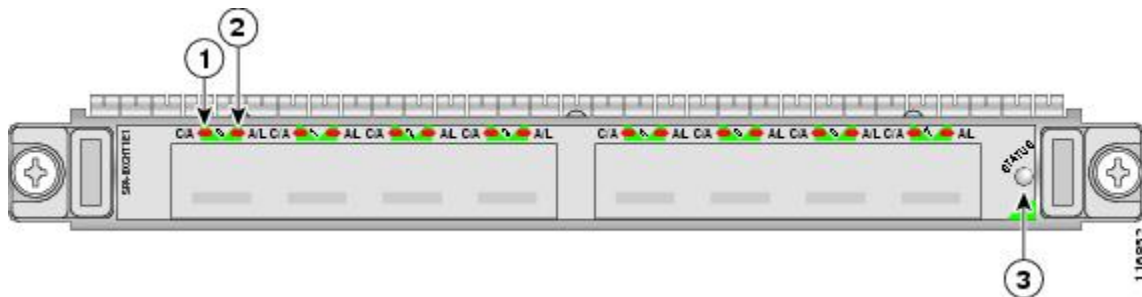
The following sections describe the 8-Port Channelized T1/E1 SPA:

### 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 the following figure.



Figure 18: 8-Port Channelized T1/E1 SPA Faceplate



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

The 8-Port Channelized T1/E1 SPA LEDs are described in the following table.

Table 14: 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 shielded twisted pair (STP) cables.



**Caution** Shielded twisted pair (STP) T1/E1 cables must be used to comply with EN55022/CISPR22 Class A emissions requirements. For revisions 73-8358-05 through 73-8358-08 Shielded Twisted pair (STP) T1/E1 cables must be used to comply with FCC Class A emissions requirements.

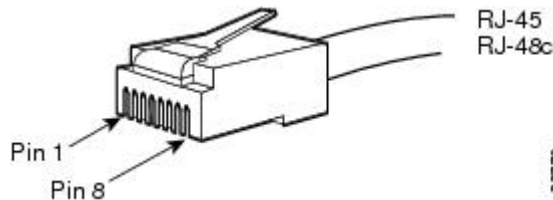
## 8-Port Channelized T1/E1 SPA Cables, Connectors, and Pinouts

The following figure 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 19: RJ-45 Connector*



The following table describes the signals and connector pinouts for RJ-45 cable connectors.

*Table 15: 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

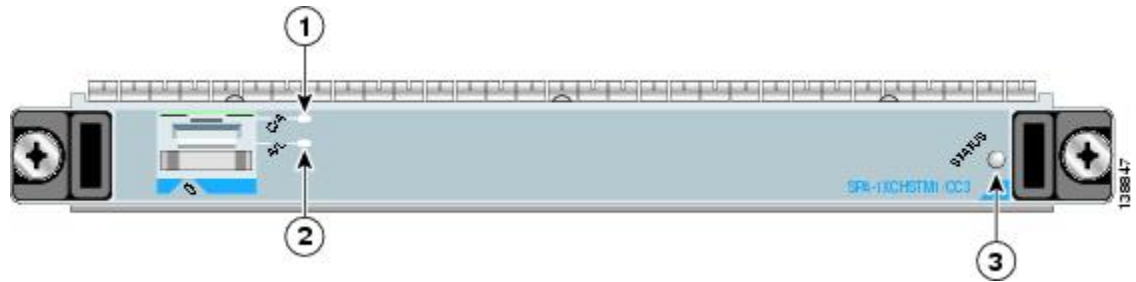
## 1-Port Channelized STM-1/OC-3 SPA Overview

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

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

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

Figure 20: 1-Port Channelized STM-1/OC-3 SPA Faceplate



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

The 1-Port Channelized STM-1/OC-3 SPA LEDs are described in the following table.

Table 16: 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).

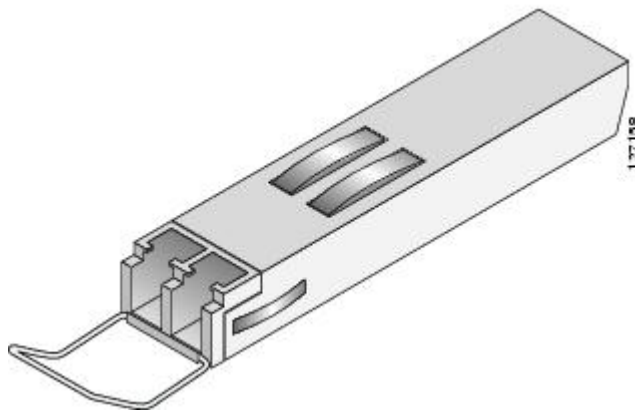


**Note** The 1-Port Channelized STM-1/OC-3 SPA supports Frame Relay Fragmentation (FRF.12) and Multilink Frame Relay (MFR) features for Cisco IOS XR Software Release 4.0.1 and later releases.

## 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 the port for SONET and SDH single-mode and multimode optical fiber connection (see the below figure).

**Figure 21: 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)

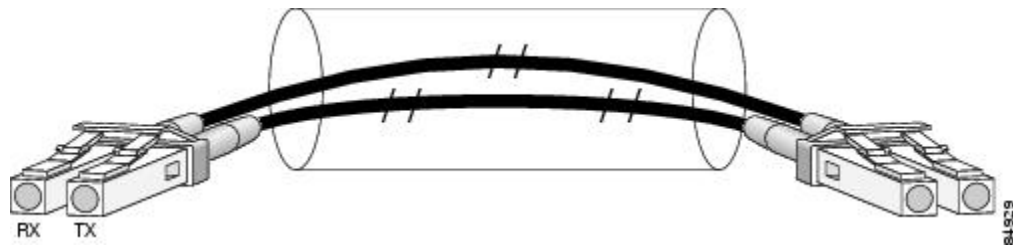
Use a single-mode optical fiber that has a modal-field diameter of  $8.7 \pm 0.5$  microns. (Nominal diameter is approximately 10/125 microns.)

For single-mode and multimode optical fiber connections, you can use either a duplex LC-type cable (see the below figure) 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 22: LC Type Cable



The 1-Port Channelized STM-1/OC-3 SPA is a single-height SPA that installs into one SIP subslot. The 1-Port Channelized STM-1/OC-3 SPA with small form-factor pluggable (SFP) optical transceiver modules supports SONET and SDH protocols with a per-port bandwidth of 155.52 Mbps. The 1-Port Channelized STM-1/OC-3 SPA operates at quarter rate.



**Note** When SFP modules are replaced, the SPA interface retains any previously defined configurations. These configurations include settings for IP address, clock source, loopback, Cyclic Redundancy Check (CRC), and POS flags.

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 “SIP and SPA Product Overview” chapter in this guide.

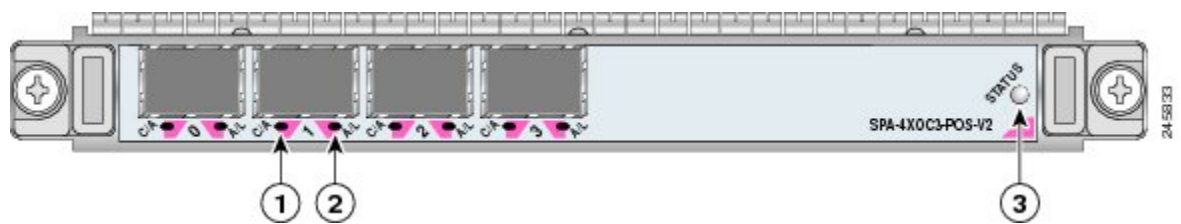
## 4-Port OC-3/STM-1 POS SPA Overview

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

### 4-Port OC-3/STM-1 POS SPA LEDs

The 4-Port OC-3/STM-1 POS SPA has three types of LEDs: two LEDs for each port on the SPA and one STATUS LED. The following figure shows the 4-Port OC-3/STM-1 POS SPA.

Figure 23: 4-Port OC-3/STM-1 POS SPA Faceplate



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

The following table describes the 4-Port OC-3/STM-1 POS SPA LEDs.

Table 17: 4-Port OC-3/STM-1 POS SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	SONET controller is shut down.
	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	Interface is shut down.
	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 is off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and good, and the SPA is being configured.

## 4-Port OC-3/STM-1 POS SPA Interface Specifications

The framer processes incoming and outgoing SONET or SDH frames. The framer operates at OC-3c/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-3c/STM-1 frame.

The 4-Port OC-3/STM-1 POS SPA interface complies with the following RFCs:

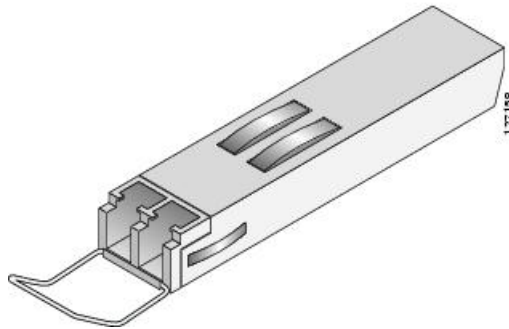
- RFC 1662, *PPP in HDLC-like Framing*
- RFC 2427, *Multiprotocol Interconnect over Frame Relay*
- RFC 2615, *PPP over SONET/SDH*

## 4-Port OC-3/STM-1 POS SPA Optical Transceiver Modules and Cables

The 4-Port OC-3/STM-1 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 the below figure).

Cisco Systems qualifies the optics that are approved for use with its SPAs. The 4-Port OC-3/STM-1 POS SPA supports the following types of optical transceiver modules:

- Multimode (MM) SFP module—SFP-OC3-MM
- Short-reach (SR) SFP module—SFP-OC3-SR
- Intermediate-reach (IR) SFP module (15 km)—SFP-OC3-IR1
- Long-reach (LR) SFP module (40 km)—SFP-OC3-LR1
- Long-reach (LR) SFP module (80 km)—SFP-OC3-LR2

**Figure 24: SFP Optics Module**

The SFP optical transceiver modules used with the 4-Port OC-3/STM-1 POS SPA 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.

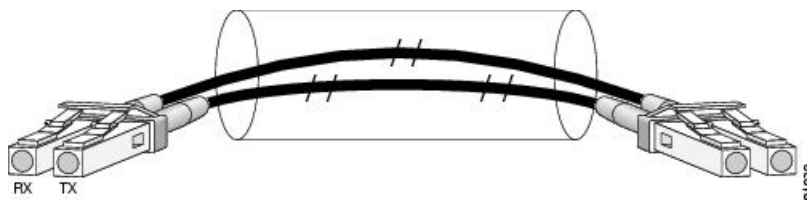
- Single-mode—155-Mbps, OC-3c/STM-1 optical fiber (SONET STS-3c or SDH STM-1)

Use a single-mode optical fiber that has a modal-field diameter of  $8.7 \pm 0.5$  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 the below figure) or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

Use single-mode (for intermediate-reach or long-reach configurations) or multimode optical fiber cable to connect your router to a network or to connect two 4-Port OC-3/STM-1 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 them.

**Figure 25: LC-Type Cable**

## OC-3 Module Connections

The following table shows the OC-3 specifications of the optics on the 4-Port OC-3/STM-1 POS SPA.

**Table 18: OC-3 Specifications**

Specification	Description
Wavelength	OC-3 MM: 1270 nm to 1380 nm OC-3 SR: 1260 nm to 1360 nm OC-3 IR-1: 1261 nm to 1360 nm OC-3 LR-1: 1263 nm to 1360 nm OC-3 LR-2: 1480 nm to 1580 nm

Specification	Description
Cabling distance (maximum)	OC-3 MM: 2 km (1.2 miles) OC-3 SR: 2 km (1.2 miles) OC-3 IR-1: 15 km (9.3 miles) OC-3 LR-1: 40 km (24.8 miles) OC-3 LR-2: 80 km (49.7 miles)
Operating case temperature range	OC-3 MM: 23 to 185 degrees F (–5 to 85 degrees C) OC-3 SR: 23 to 185 degrees F (–5 to 85 degrees C) OC-3 IR-1: 23 to 185 degrees F (–5 to 85 degrees C) OC-3 LR-1: 23 to 185 degrees F (–5 to 85 degrees C) OC-3 LR-2: 23 to 185 degrees F (–5 to 85 degrees C)
TX power	OC-3 MM: –19 to –14 dBm OC-3 SR: –15 to –8 dBm OC-3 IR-1: –15 to –8 dBm OC-3 LR-1: –5 to 0 dBm OC-3 LR-2: –5 to 0 dBm
Receiver sensitivity (maximum)	OC-3 MM: –30 dBm OC-3 SR: –23 dBm OC-3 IR-1: –28 dBm OC-3 LR-1: –34 dBm OC-3 LR-2: –34 dBm
RX overload	OC-3 MM: –5 dBm OC-3 SR: –8 dBm OC-3 IR-1: –8 dBm OC-3 LR-1: –10 dBm OC-3 LR-2: –10 dBm
Maximum receiver power damage	OC-3 MM: +5 dBm OC-3 SR: +5 dBm OC-3 IR-1: +5 dBm OC-3 LR-1: +5 dBm OC-3 LR-2: +5 dBm

## 8-Port OC-3/STM-1 POS SPA Overview

The 8-Port OC-3/STM-1 POS SPA is a single-height SPA that installs into one SIP subslot. The SPA with small form-factor pluggable (SFP) optical transceiver modules provides Optical Carrier Level (OC-*n*) for SONET and Synchronous Transport Module (STM-*n*) for SDH network connectivity. On this SPA, any given port can use an OC-3 SFP module, so the per-port bandwidth can be 155.52 Mbps.



**Note** When SFP modules are replaced, the SPA interface retains any previously defined configurations. These configurations include settings for IP address, clock source, loopback, CRC, and POS flags.

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.

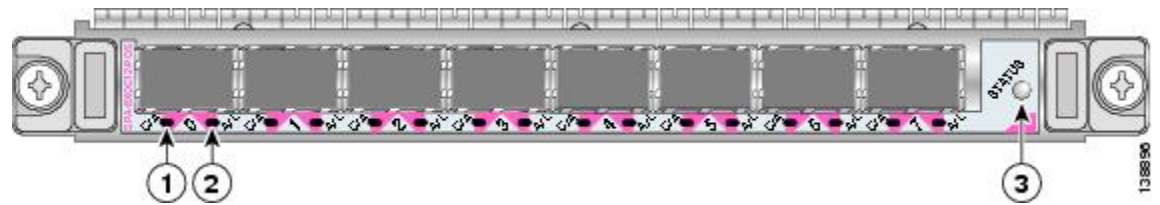
The following sections describe the 8-Port OC-3/STM-1 POS SPA:

### 8-Port OC-3/STM-1 POS SPA LEDs

The 8-Port OC-3/STM-1 POS SPA has three types of LEDs: two LEDs for each port on the SPA and one STATUS LED. The following figure shows the 8-Port OC-3/STM-1 POS SPA faceplate.



Figure 26: 8-Port OC-3/STM-1 POS SPA Faceplate



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

The following table describes the 8-Port OC-3/STM-1 POS SPA LEDs.

Table 19: 8-Port OC-3/STM-1 POS SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	SONET controller is shut down.
	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	Interface is shut down.
	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 is off.
	Green	On	SPA is ready and operational.
	Amber	On	SPA power is on and good, and the SPA is being configured.

## 8-Port OC-3/STM-1 POS SPA Interface Specifications

The framer processes incoming and outgoing SONET or SDH frames. The framer operates at OC-3 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 Layer 2 frame.

The 8-Port OC-3/STM-1 POS SPA interface complies with the following RFCs:

- RFC 1662, *PPP in HDLC-like Framing*
- RFC 2427, *Multiprotocol Interconnect over Frame Relay*
- RFC 2615, *PPP over SONET/SDH*

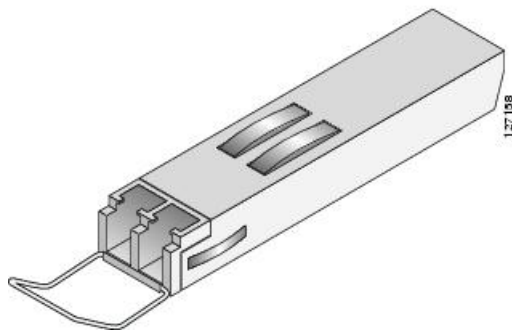
## 8-Port OC-3/STM-1 POS SPA Optical Transceiver Modules and Cables

The 8-Port OC-3/STM-1 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 connections (see the following figure).

Cisco Systems qualifies the optics that are approved for use with its SPAs. The following OC-3 optical transceiver modules are supported on the 8-Port OC-3/STM-1 POS SPA:

- Multimode (MM) SFP module—SFP-OC3-MM
- Short-reach (SR) SFP module—SFP-OC3-SR
- Intermediate-reach (IR) SFP module (15 km)—SFP-OC3-IR1
- Long-reach (LR) SFP module (40 km)—SFP-OC3-LR1
- Long-reach (LR) SFP module (80 km)—SFP-OC3-LR2

**Figure 27: SFP Optics Module**



The following OC-3 optical fiber options are available for the 8-Port OC-3/STM-1 POS SPA:

- Multimode—155.52-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—155.52-Mbps, OC-3 optical fiber (SONET STS-3c or SDH STM-1)

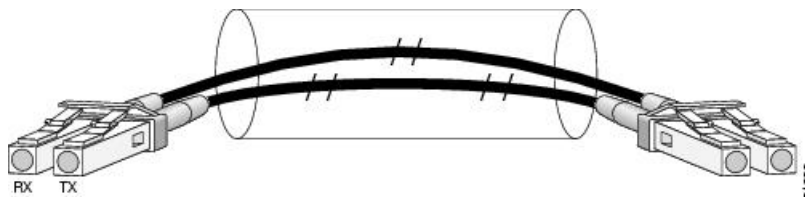
Use a single-mode optical fiber that has a modal-field diameter of  $8.7 \pm 0.5$  microns. (Nominal diameter is approximately 10/125 microns.)

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

Use single-mode (for short-, intermediate- or long-reach configurations) or multimode optical fiber cable to connect your router to a network or two OC-3-equipped or OC-12-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 them.

**Figure 28: LC-Type Cable**



## OC-3 Module Connections

The following table shows the OC-3 specifications of the optics on the 8-Port OC-3/STM-1 POS SPA.

**Table 20: OC-3 Specifications**

Specification	Description
Wavelength	OC-3 MM: 1270 nm to 1380 nm OC-3 SR: 1260 nm to 1360 nm OC-3 IR-1: 1261 nm to 1360 nm OC-3 LR-1: 1263 nm to 1360 nm OC-3 LR-2: 1480 nm to 1580 nm
Cabling distance (maximum)	OC-3 MM: 2 km (1.2 miles) OC-3 SR: 2 km (1.2 miles) OC-3 IR-1: 15 km (9.3 miles) OC-3 LR-1: 40 km (24.8 miles) OC-3 LR-2: 80 km (49.7 miles)
Operating case temperature range	OC-3 MM: 23 to 185 degrees F (–5 to 85 degrees C) OC-3 SR: 23 to 185 degrees F (–5 to 85 degrees C) OC-3 IR-1: 23 to 185 degrees F (–5 to 85 degrees C) OC-3 LR-1: 23 to 185 degrees F (–5 to 85 degrees C) OC-3 LR-2: 23 to 185 degrees F (–5 to 85 degrees C)
TX power	OC-3 MM: –19 to –14 dBm OC-3 SR: –15 to –8 dBm OC-3 IR-1: –15 to –8 dBm OC-3 LR-1: –5 to 0 dBm OC-3 LR-2: –5 to 0 dBm
Receiver sensitivity (maximum)	OC-3 MM: –30 dBm OC-3 SR: –23 dBm OC-3 IR-1: –28 dBm OC-3 LR-1: –34 dBm OC-3 LR-2: –34 dBm
RX overload	OC-3 MM: –5 dBm OC-3 SR: –8 dBm OC-3 IR-1: –8 dBm OC-3 LR-1: –10 dBm OC-3 LR-2: –10 dBm
Maximum receiver power damage	OC-3 MM: +5 dBm OC-3 SR: +5 dBm OC-3 IR-1: +5 dBm OC-3 LR-1: +5 dBm OC-3 LR-2: +5 dBm

## 1-Port Channelized OC-3 ATM CEoP SPA Overview

The following sections describe the 1-Port Channelized OC-3 ATM CEoP SPA:

- 1-Port Channelized OC-3 ATM CEoP SPA LEDs
- 1-Port Channelized OC-3 ATM CEoP SPA Interface Specifications
- 1-Port Channelized OC-3 ATM CEoP SPA Optical Transceiver Modules and Cables

### 1-Port Channelized OC-3 ATM CEoP SPA LEDs

The 1-Port Channelized OC-3 ATM CEoP SPA has three types of LEDs. There are two LEDs for the port on the SPA, and one STATUS LED as shown in the following figure.

Figure 29: 1-Port Channelized OC-3 ATM CEoP SPA Faceplate



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

The 1-Port Channelized OC-3 ATM CEoP SPA LEDs are described in the following table.

Table 21: 1-Port Channelized OC-3 ATM CEoP SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software.
	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 Channelized OC-3 ATM CEoP SPA Interface Specifications

The physical layer interface for the 1-Port Channelized OC-3 ATM CEoP SPA is Optical Carrier-3 (OC-3). The 1-Port Channelized OC-3 ATM CEoP SPA provides one 155.52-Mbps OC-3 network interface for all supported platforms.

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

## 1-Port Channelized OC-3 ATM CEoP SPA Optical Transceiver Modules and Cables

Cisco Systems qualifies the optics that are approved for use with its SPAs. The 1-Port Channelized OC-3 ATM CEoP SPA supports the following types of optical transceiver modules:

- Multimode (MM) SFP module—SFP-OC3-MM
- Short Reach (SR) SFP module—SFP-OC3-SR
- Intermediate Reach (IR) SFP module (15 km)—SFP-OC3-IR1
- Long Reach (LR) SFP module (40 km)—SFP-OC3-LR1
- Long Reach 2 (LR2) SFP module (80 km)—SFP-OC3-LR2

## 1-Port and 3-Port Clear Channel OC-3 ATM SPA Overview

The 1-Port and 3-Port Clear Channel OC-3 ATM SPA is a single-height SPA that installs into one SIP subslot. The Clear Channel OC-3 ATM SPA with small form-factor pluggable (SFP) optical transceiver modules provides 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 in this chapter.

The following sections describe the 1-Port and 3-Port Clear Channel OC-3 ATM SPA:

### 1-Port and 3-Port Clear Channel OC-3 ATM SPA LEDs

The 1-Port and 3-Port Clear Channel OC-3 ATM SPA has three types of LEDs. There are two LEDs for each port on the SPA, and one STATUS LED. The following figure shows an example of these LEDs on a 3-Port Clear Channel OC-3 ATM SPA.

Figure 30: 3-Port Clear Channel OC-3 ATM SPA Faceplate



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

The 1-Port and 3-Port Clear Channel OC-3 ATM SPA LEDs are described in the table below.

Table 22: 1-Port and 3-Port Clear Channel OC-3 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, and loopback is off.

LED Label	Color	State	Meaning
	Amber	On	Port is enabled by software, and 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 and 3-Port Clear Channel OC-3 ATM SPA Interface Specifications

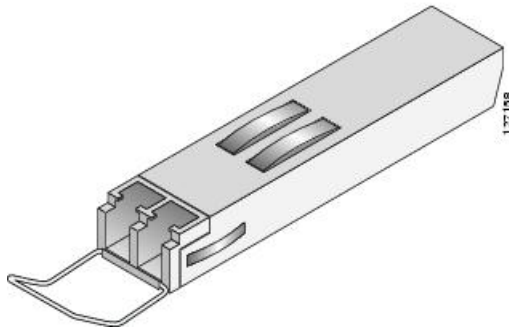
The physical layer interface for the 1-Port and 3-Port Clear Channel OC-3 ATM SPA is Optical Carrier-3 (OC-3), and the data link layer is designed to comply with ATM specifications. The 1-Port and 3-Port Clear Channel OC-3 ATM SPA provides up to one and three 155-Mbps OC-3 network interfaces, respectively, 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.

## 1-Port and 3-Port Clear Channel OC-3 ATM SPA Cables and Connectors

The 1-Port and 3-Port Clear Channel OC-3 ATM 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.

**Figure 31: SFP Optics Module**



The SFP optical transceiver modules used with the 1-Port and 3-Port Clear Channel OC-3 ATM SPA 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)

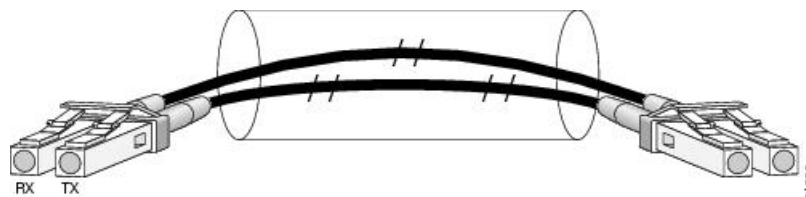
Use a single-mode optical fiber that has a modal-field diameter of  $8.7 \pm 0.5$  microns. (Nominal diameter is approximately 10/125 microns.)

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

Use a single-mode (for intermediate-reach 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 optical transceiver modules (for long-reach configurations) cannot be connected back-to-back without using an attenuator between them.

Figure 32: Duplex Patch Cable with LC-Type Connectors



## 1-Port Clear Channel OC-12 ATM SPA Overview

The 1-Port Clear Channel OC-12 ATM SPA is a single-height ATM SPA that can be installed into one SIP subslot. The OC-12 ATM SPA with small form-factor pluggable (SFP) optical transceiver modules provides SONET and SDH network connectivity with a per-port bandwidth of 622.08 Mbps. For more information about SPA bandwidth, see the “Bandwidth Oversubscription” section in this chapter.

The following sections describe the 1-Port Clear Channel OC-12 ATM SPA:

### 1-Port Clear Channel OC-12 ATM SPA LEDs

The 1-Port Clear Channel OC-12 ATM SPA has three types of LEDs. There are two LEDs for the port on the SPA, and one STATUS LED, as shown in the following figure.

Figure 33: 1-Port Clear Channel OC-12 ATM SPA Faceplate



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

The 1-Port Clear Channel OC-12 ATM SPA LEDs are described in the following table.

Table 23: 1-Port Clear Channel OC-12 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.

LED Label	Color	State	Meaning
	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, and loopback is off.
	Amber	On	Port is enabled by software, and 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 Clear Channel OC-12 ATM SPA Interface Specifications

The physical layer interface for the 1-Port Clear Channel OC-12 ATM SPA is Optical Carrier-12 (OC-12), and the 1-Port Clear Channel OC-12 ATM SPA is designed to comply with ATM specifications. The 1-Port Clear Channel OC-12 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 Clear Channel OC-12 ATM SPA Cables and Connectors

The 1-Port Clear Channel OC-12 ATM 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 the below figure).

The 1-Port Clear Channel OC-12 ATM SPA supports the following types of optical transceiver modules:

Multimode (MM) SFP module—SFP-OC12-MM

Short-reach (SR) SFP module—SFP-OC12-SR

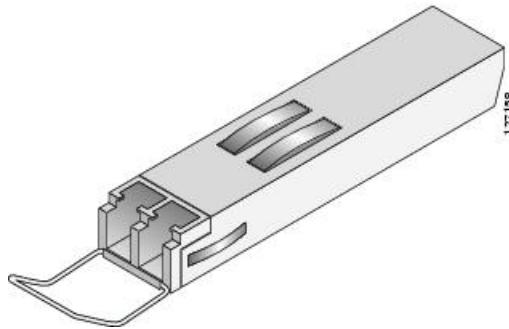
Intermediate-reach (IR) SFP module (15 km)—SFP-OC12-IR1

Long-reach (LR) SFP module (40 km)—SFP-OC12-LR1

Long-reach (LR) SFP module (80 km)—SFP-OC12-LR2

The SR, IR, and LR1 transceivers provide a full-duplex 622.08-Mbps, laser-based SONET/SDH-compliant interface with an average wavelength of 1310 nm. The LR2 transceivers provide a full-duplex, 622.08-Mbps, laser-based SONET/SDH-compliant interface with an average wavelength of 1530 nm. The multimode transceiver provides a full-duplex, 622.08-Mbps, LED-based SONET/SDH-compliant interface with an average wavelength of 1325 nm.



**Figure 34: SFP Optics Module**

The 1-Port Clear Channel OC-12 ATM SPA provides the following optical fiber options:

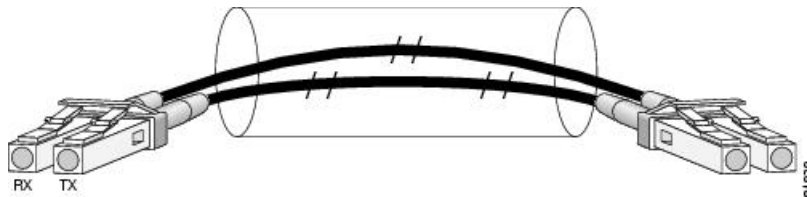
- Multimode—622.08-Mbps, OC-12 optical fiber (SONET STS-12c or SDH STM-4)

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  $8.7 \pm 0.5$  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 or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

**Figure 35: Duplex Patch Cable with LC-Type Connectors**

## 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA Overview

The 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA is a single-height OC-12 SPA that can be installed into one SIP subslot. The OC-12 SPA with small form-factor pluggable (SFP) optical transceiver modules provides SONET and SDH network connectivity. Since any given channel can be configured as either OC-3 or OC-12, so the per-port bandwidth can be either 155.52 Mbps or 622.08 Mbps respectively, depending on the type of small form-factor pluggable (SFP) optical transceiver module installed.



**Note** When SFP modules are replaced, the SPA interface retains any previously-defined configurations. This includes settings for IP address, clock source, loopback, CRC, and POS flags.

The 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA is a half rate SPA.

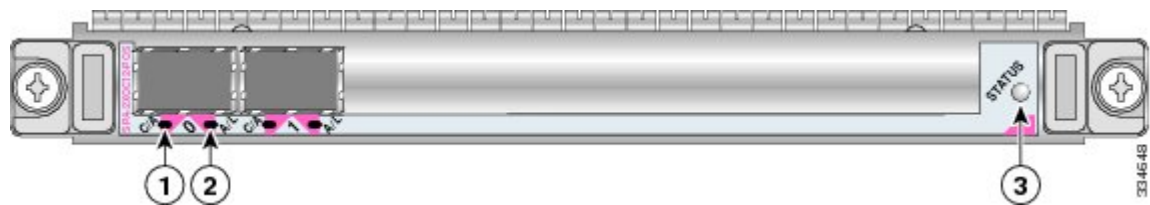
For more information about SPA bandwidth, see the “Bandwidth Oversubscription” topic in this chapter. For more information about SPAs and their compatibility with SIPs and modular optics, see the “SIP and SPA Product Overview” chapter in this guide.

The following sections describe the 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA:

## 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA LEDs

The 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA has three LEDs: two LEDs for each port on the SPA and one STATUS LED. The following figure shows the 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA faceplate.

**Figure 36: 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA Faceplate**



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

The 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA LEDs are described in the following table.

**Table 24: 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA LEDs**

LED Label	Color	State	Meaning
C/A	Off	Off	SONET controller is shut down.
	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	Interface is shut down.
	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; SPA is being configured.

## 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA Interface Specifications

The framer processes incoming and outgoing SONET or SDH frames. The framer operates at OC-3 line rates (155.52 Mbps) and OC-12 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 layer 2 frame.

The 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA interface complies with the following IETF RFCs:

- RFC 1662, *PPP in HDLC-like Framing*
- RFC 2427, *Frame Relay Encapsulation*
- RFC 2615, *PPP over SONET/SDH*

## 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA Optical Transceiver Modules and Cables

The 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA uses an SFP optical transceiver module installed in each port for SONET and SDH single-mode and multimode optical fiber connection (see the below figure).

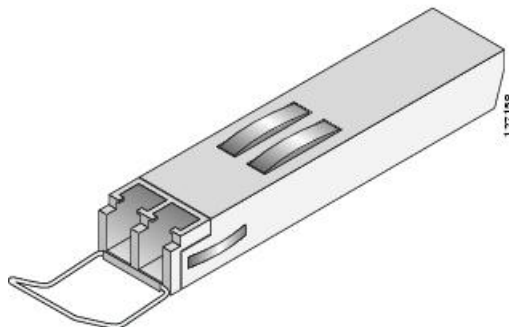
Cisco Systems qualifies the optics that are approved for use with its SPAs. The 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA when configured as OC-3 supports the following types of optical transceiver modules:

- Multimode (MM) SFP module—SFP-OC3-MM
- Short reach (SR) SFP module—SFP-OC3-SR
- Intermediate reach (IR) SFP module (15 km)—SFP-OC3-IR1
- Long reach (LR) SFP module (40 km)—SFP-OC3-LR1
- LR SFP module (80 km)—SFP-OC3-LR2

The 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA when configured as OC-12 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 37: SFP Optics Module**



The SFP optical transceiver modules used with the 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA configured for OC-3 provide the following optical fiber options:

- Multimode—155.52-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—155.52-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  $8.7 \pm 0.5$  microns. (Nominal diameter is approximately 10/125 microns.)

The SFP optical transceiver modules used with the 2-Port OC-3 STM-1/OC-12 STM-4 POS SPA configured for OC-12 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.

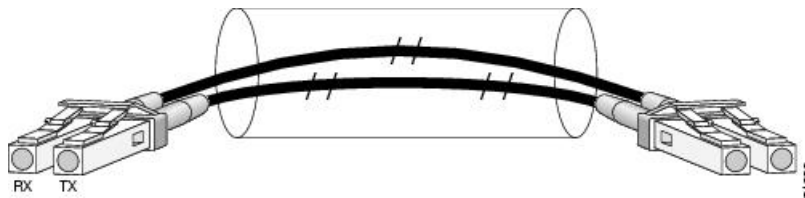
- Single-mode—622.08-Mbps, OC-12 optical fiber (SONET STS-12c or SDH STM-4)

Use a single-mode optical fiber that has a modal-field diameter of  $8.7 \pm 0.5$  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 or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

Use single-mode (for short-, intermediate- or long-reach configurations) or multimode optical fiber cable to connect your router to a network or to connect two OC-3-equipped or OC-12-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 38: LC-Type Cable**



## 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA Overview

The 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA is a single-height OC-12 SPA that can be installed into one SIP subslot. The OC-12 SPA with small form-factor pluggable (SFP) optical transceiver modules provides SONET and SDH network connectivity. Since any given channel can be configured as either OC-3 or OC-12, so the per-port bandwidth can be either 155.52 Mbps or 622.08 Mbps respectively, depending on the type of small form-factor pluggable (SFP) optical transceiver module installed.



**Note** When SFP modules are replaced, the SPA interface retains any previously-defined configurations. This includes settings for IP address, clock source, loopback, CRC, and POS flags.

The 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA is a half rate SPA.

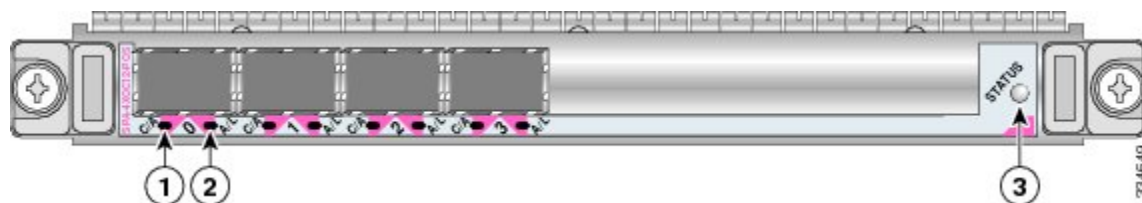
For more information about SPA bandwidth, see the “Bandwidth Oversubscription” topic in this chapter. For more information about SPAs and their compatibility with SIPs and modular optics, see the “SIP and SPA Product Overview” chapter in this guide.

The following sections describe the 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA:

## 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA LEDs

The 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA has three LEDs: two LEDs for each port on the SPA and one STATUS LED. The following figure shows the 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA faceplate.

Figure 39: 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA Faceplate



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

The 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA LEDs are described in the following table.

Table 25: 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	SONET controller is shut down.
	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	Interface is shut down.
	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; SPA is being configured.

## 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA Interface Specifications

The framer processes incoming and outgoing SONET or SDH frames. The framer operates at OC-3 line rates (155.52 Mbps) and OC-12 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 layer 2 frame.

The 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA interface complies with the following IETF RFCs:

- RFC 1662, *PPP in HDLC-like Framing*
- RFC 2427, *Frame Relay Encapsulation*
- RFC 2615, *PPP over SONET/SDH*

## 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA Optical Transceiver Modules and Cables

The 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA uses an SFP optical transceiver module installed in each port for SONET and SDH single-mode and multimode optical fiber connection (see the figure below).

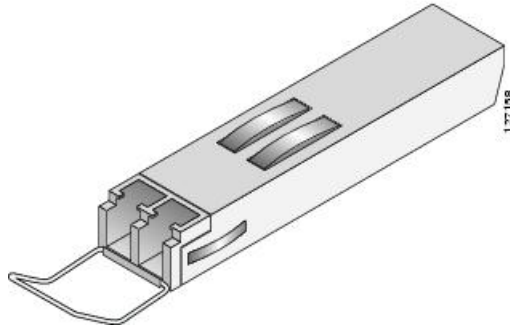
Cisco Systems qualifies the optics that are approved for use with its SPAs. The 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA when configured as OC-3 supports the following types of optical transceiver modules:

- Multimode (MM) SFP module—SFP-OC3-MM
- Short reach (SR) SFP module—SFP-OC3-SR
- Intermediate reach (IR) SFP module (15 km)—SFP-OC3-IR1
- Long reach (LR) SFP module (40 km)—SFP-OC3-LR1
- LR SFP module (80 km)—SFP-OC3-LR2

The 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA when configured as OC-12 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 40: SFP Optics Module**



The SFP optical transceiver modules used with the 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA configured for OC-3 provide the following optical fiber options:

- Multimode—155.52-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—155.52-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  $8.7 \pm 0.5$  microns. (Nominal diameter is approximately 10/125 microns.)

The SFP optical transceiver modules used with the 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA configured for OC-12 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.

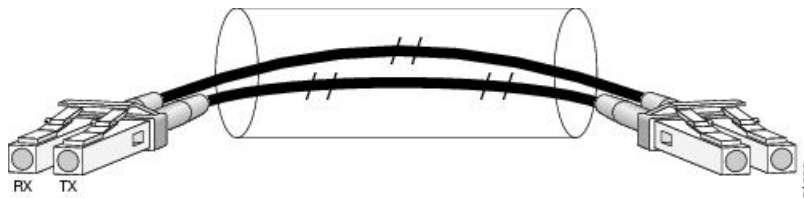
- Single-mode—622.08-Mbps, OC-12 optical fiber (SONET STS-12c or SDH STM-4)

Use a single-mode optical fiber that has a modal-field diameter of  $8.7 \pm 0.5$  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 or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

Use single-mode (for short-, intermediate- or long-reach configurations) or multimode optical fiber cable to connect your router to a network or to connect two OC-3-equipped or OC-12-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 41: LC-Type Cable**



## 4-Port OC-48/STM-16 POS/RPR SPA Overview

The 4-Port OC-48/STM-16 POS/RPR SPA is a single-height OC-48 SPA that can be installed into one SIP subslot. The OC-48 SPA with small form-factor pluggable (SFP) optical transceiver modules provides SONET and SDH network connectivity. The 4-Port OC-48/STM-16 POS/RPR SPA supports a per-port bandwidth of 2.488 Gbps.



**Note** When SFP modules are replaced, the SPA interface retains any previously-defined configurations. This includes settings for IP address, clock source, loopback, CRC, and POS flags.

The 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA is a half rate SPA.

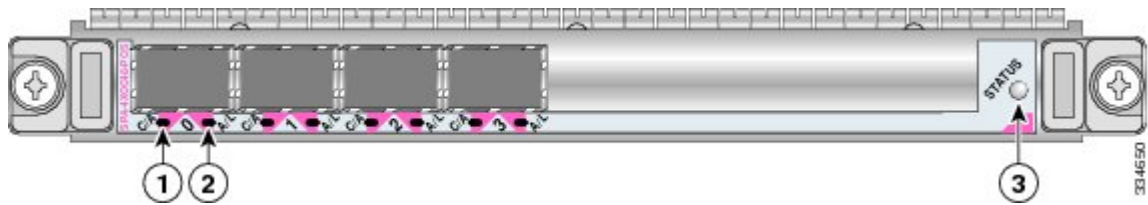
For more information about SPA bandwidth, see the “Bandwidth Oversubscription” topic in this chapter. For more information about SPAs and their compatibility with SIPs and modular optics, see the “SIP and SPA Product Overview” chapter in this guide.

The following sections describe the 4-Port OC-48/STM-16 POS/RPR SPA:

### 4-Port OC-48/STM-16 POS/RPR SPA LEDs

The 4-Port OC-48/STM-16 POS/RPR SPA has five types of LEDs: four LEDs for each port on the SPA and one STATUS LED, as shown in the following figure.

Figure 42: 4-Port OC-48/STM-16 POS/RPR SPA Faceplate



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

The following table describes the 4-Port OC-48/STM-16 POS/RPR SPA LEDs.

Table 26: 4-Port OC-3 STM-1/OC-12 STM-4 POS SPA LEDs

LED Label	Color	State	Meaning
C/A	Off	Off	SONET controller is shut down.
	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	Interface is shut down.
	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; SPA is being configured.

## 4-Port OC-48/STM-16 POS/RPR SPA Interface Specifications

The physical layer interface for the 4-Port OC-48/STM-16 POS/RPR SPA is Optical Carrier-48 (OC-48), which provides SONET and SDH network connectivity with a per-port bandwidth of 2.488 Gbps.

Each port on the has one duplex LC-type receptacle that allows connection to single-mode optical fiber.

## 4-Port OC-48/STM-16 POS/RPR SPA Cables, Optical Transceiver Modules, and Connectors

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

The 4-Port OC-48/STM-16 POS/RPR SPA supports the following types of optical transceiver modules:

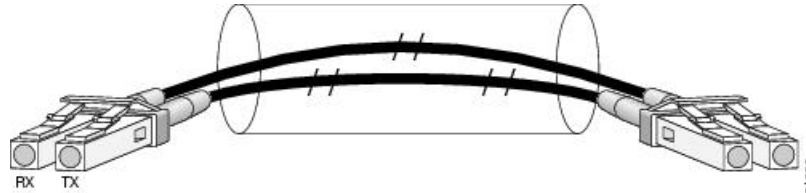
- Single-mode short-reach (SR) SFP module—SFP-OC48-SR OC48/STM16c



- Single-mode intermediate-reach (IR) SFP module—SFP-OC48-IR1 OC48/STM16c
- Single-mode long-reach (LR) SFP module—SFP-OC48-LR2 OC48/STM16c

Each port on the 4-Port OC-48/STM-16 POS/RPR SPA has one duplex LC-type receptacle. For single-mode optical fiber connections, you can use either a duplex LC-type cable or two simplex LC-type cables, one for transmit (TX) and one for receive (RX).

**Figure 43: LC-Type Cable**



## OC-48 Module Connections

The following table shows the OC-48 specifications for use with the 4-Port OC-48/STM-16 POS/RPR SPA.

**Table 27: OC-48 Specifications**

Specification	Description
Wavelength	OC-48 SR: 1266 nm to 1360 nm OC-48 IR-1: 1260 nm to 1360 nm OC-48 LR-2: 1500 nm to 1580 nm
Cabling distance (maximum)	OC-48 SR: 2 km (1.2 miles) OC-48 IR-1: 15 km (9.3 miles) OC-48 LR-2: 80 km (49.7 miles)
Operating case temperature range	OC-48 SR: 23 to 158 degrees F (–5 to 70 degrees C) OC-48 IR-1: 23 to 158 degrees F (–5 to 70 degrees C) OC-48 LR-2: 23 to 158 degrees F (–5 to 70 degrees C)
TX power	OC-48 SR: –10 to –3 dBm OC-48 IR-1: –5 to 0 dBm OC-48 LR-2: –2 to +3 dBm
Receiver sensitivity (maximum)	OC-48 SR: –18 dBm OC-48 IR-1: –18 dBm OC-48 LR-2: –28 dBm
RX overload	OC-48 SR: –3 dBm OC-48 IR-1: 0 dBm OC-48 LR-2: –9 dBm
Maximum receiver power damage	OC-48 SR: +5 dBm OC-48 IR-1: +5 dBm OC-48 LR-2: +5 dBm

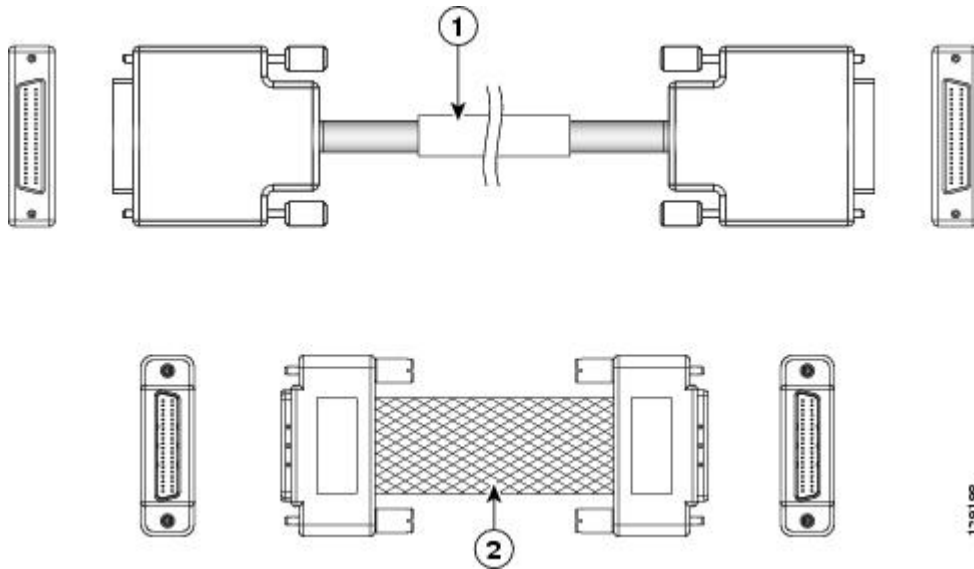
## Mate Interface Cables

The 4-Port OC-48/STM-16 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 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. The following figure shows the mate cables used to connect the SPAs.

Figure 44: 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)
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## 2-Port Channelized T3/E3 ATM CCoP SPA Overview

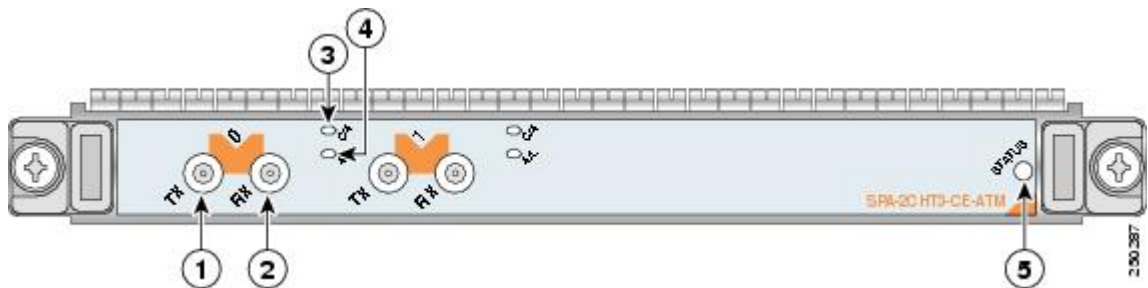
The following sections describe the 2-Port Channelized T3/E3 ATM CCoP SPA:

- [2-Port Channelized T3/E3 ATM CCoP SPA LEDs, on page 50](#)
- [2-Port Channelized T3/E3 ATM CCoP SPA Interface Specifications, on page 51](#)
- [2-Port Channelized T3/E3 ATM CCoP SPA Cables and Connectors, on page 51](#)

### 2-Port Channelized T3/E3 ATM CCoP SPA LEDs

The 2-Port Channelized T3/E3 ATM CCoP SPA has three types of LEDs (see the following figure). There are two LEDs for each port on the SPA, and a single STATUS LED for the SPA.

Figure 45: 2-Port Channelized T3/E3 ATM CCoP SPA Faceplate



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

The 2-Port Channelized T3/E3 ATM CEoP SPA LEDs are described in the following table.

**Table 28: 2-Port Channelized T3/E3 ATM CEoP SPA LEDs**

LED Label	Color	State	Meaning
C/A	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software.
	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 the SPA is being configured.
	Green	On	SPA is ready and operational.

## 2-Port Channelized T3/E3 ATM CEoP SPA Interface Specifications

The framer processes the incoming and outgoing T3 (C-Bit, m13/m23, and unframe) and E3 (g751) frames. The framer operates at T3 or E3 line rates (44.736 or 34.368 Mbps), depending on the mode in which it is configured.

The T3 or E3 data is encapsulated and sent across the MPLS network over user-configurable pseudowires. In the ATM, the data is encapsulated into ATM cells and transported across the network.

The T3/E3 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 Channelized T3/E3 ATM CEoP SPA Cables and Connectors

The interface connectors on the 2-Port Channelized T3/E3 ATM CEoP SPA are 75-ohm coaxial DIN 1.0/2.3 types, with one connector and cable for transmit (TX) and one for receive (RX).

The following cables can be used with the 2-Port Channelized T3/E3 ATM CEoP SPA. The cables have BNC connectors on one end and DIN 1.0/2.3 connectors on the other end. If similar SPAs are connected back-to-back, both ends of the cable are DIN 1.0/2.3.

The cables specifications that can be used for the 2-Port Channelized T3/E3 ATM CEoP SPA are:

- CAB-T3E3-RF-BNC-M (T3 or E3 Cable, 1.0/2.3 RF to mini BNC-Male, 10 feet)
- CAB-T3E3-RF-BNC-F (T3 or E3 Cable, 1.0/2.3 RF to mini 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 (for the male BNC end) and 72-4131-01 (for the female BNC end). A SPA can receive data over the cable up to a maximum distance of 1350 ft (411.5 meters).

The following table describes the signal descriptions for the 2-Port Channelized T3/E3 ATM CEoP SPA connectors shown in the previous figure.

**Table 29: 2-Port Channelized T3/E3 ATM CEoP SPA Connectors**

Connector Label	Meaning
TX	Transmitted signals appear on the center contact. The outer shield is ground for the 75-ohm coaxial cable you attach to the TX DIN 1.0/2.3 connector.
RX	Received signals appear on the center contact. The outer shield is ground for the 75-ohm coaxial cable you attach to the RX DIN 1.0/2.3 connector.

## 24-Port Channelized T1/E1/J1 CEoP SPA Overview

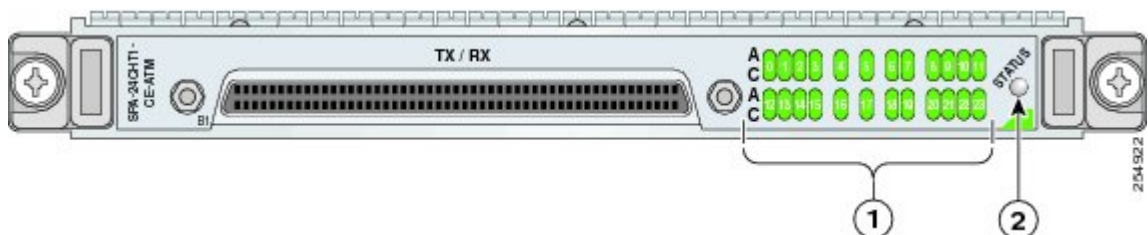
The following sections describe the 24-Port Channelized T1/E1/J1 CEoP SPA:

- [24-Port Channelized T1/E1/J1 CEoP SPA LEDs, on page 52](#)
- [24-Port Channelized T1/E1/J1 CEoP SPA Interface Specifications, on page 53](#)
- [24-Port Channelized T1/E1/J1 CEoP SPA Cables and Connectors, on page 53](#)

## 24-Port Channelized T1/E1/J1 CEoP SPA LEDs

The 24-Port Channelized T1/E1/J1 CEoP SPA has two types of LEDs, as shown in the following figure:

**Figure 46: 24-Port Channelized T1/E1/J1 CEoP SPA Faceplate**



1	A/C (Alarm/Carrier) LEDs	2	STATUS LED
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The following table describes the 24-Port Channelized T1/E1/J1 CEoP SPA LEDs.

**Table 30: 24-Port Channelized T1/E1/J1 CEoP SPA LEDs**

LED Label	Color	State	Meaning
STATUS	Off	Off	SPA power is off.

LED Label	Color	State	Meaning
	Amber	On	SPA power is on and good, and SPA is being configured.
	Green	On	SPA is ready and operational.
A/C	Off	Off	Port is not enabled by software.
	Green	On	Port is enabled by software.
	Amber	On	Port is enabled by software, and there is at least one alarm.

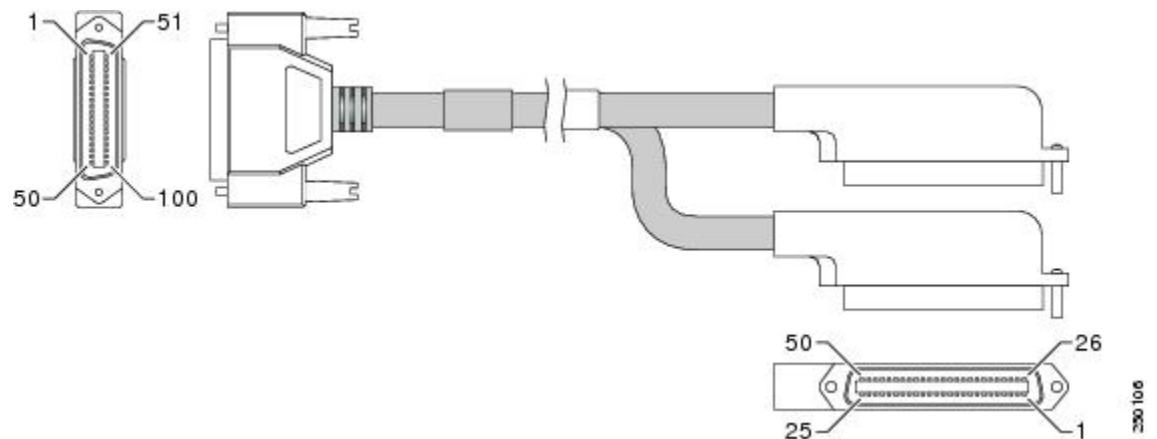
## 24-Port Channelized T1/E1/J1 CEoP SPA Interface Specifications

The physical layer interface for the 24-Port Channelized T1/E1/J1 CEoP SPA is a customer-installed high-density connector. This connector has thumbscrews that should be screwed into the SPA when the cable is installed.

## 24-Port Channelized T1/E1/J1 CEoP SPA Cables and Connectors

The 24-Port Channelized T1/E1/J1 CEoP SPA requires a Cisco cable (part number CABLE-24T1E1J1), which is shown in the figure below.

**Figure 47: 24-Port Channelized T1/E1/J1 CEoP SPA High-Density Cable**

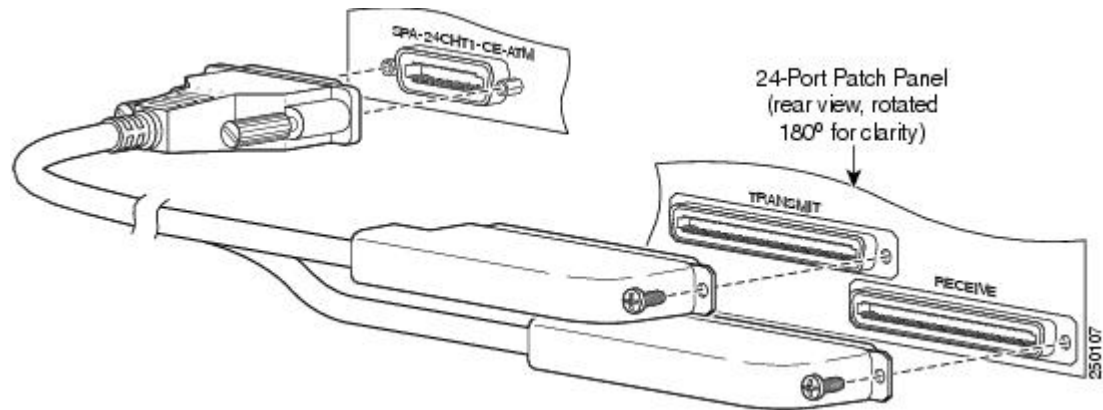


### Cable Installation

One end of the cable has a 100-pin connector that plugs into the front of the 24-Port Channelized T1/E1/J1 CEoP SPA. Use the thumbscrews on either side of the connector to secure the cable to the SPA.

The other end of the cable has two 50-pin Telco connectors that can be attached to the rear of a 24-port RJ-45 patch panel. Both connectors are identical: one is for Transmit (TX) and the other is for Receive (RX). The following figure shows how the cable is connected between the 24-Port Channelized T1/E1/J1 CEoP SPA and the patch panel.

Figure 48: Cable Installation Between the SPA and the Patch Panel



## SPA Cable Pinouts

The following table shows the cable pinouts for the cable (part number CABLE-24T1E1J1) that is installed between the 24-Port Channelized T1/E1/J1 CEoP SPA and the rear of the patch panel.

Table 31: 24-Port Channelized T1/E1/J1 CEoP SPA Cable Connector Pinouts

Subscriber	Connector Pins			
Line	Signal	SPA	TX Cable Lead	RX Cable Lead
Line 1	TX TipTX Ring	252	126	Not connected
	RX TipRX Ring	2676	Not connected	126
Line 2	TX TipTX Ring	353	227	Not connected
	RX TipRX Ring	2777	Not connected	227
Line 3	TX TipTX Ring	454	328	Not connected
	RX TipRX Ring	2878	Not connected	328
Line 4	TX TipTX Ring	555	429	Not connected
	RX TipRX Ring	2979	Not connected	429
Line 5	TX TipTX Ring	656	530	Not connected
	RX TipRX Ring	3080	Not connected	530
Line 6	TX TipTX Ring	757	631	Not connected
	RX TipRX Ring	3181	Not connected	631
Line 7	TX TipTX Ring	858	732	Not connected
	RX TipRX Ring	3282	Not connected	732

Subscriber	Connector Pins			
Line 8	TX TipTX Ring	959	833	Not connected
	RX TipRX Ring	3383	Not connected	833
Line 9	TX TipTX Ring	1060	934	Not connected
	RX TipRX Ring	3484	Not connected	934
Line 10	TX TipTX Ring	1161	1035	Not connected
	RX TipRX Ring	3585	Not connected	1035
Line 11	TX TipTX Ring	1262	1136	Not connected
	RX TipRX Ring	3686	Not connected	1136
Line 12	TX TipTX Ring	1363	1237	Not connected
	RX TipRX Ring	3787	Not connected	1237
Line 13	TX TipTX Ring	1464	1338	Not connected
	RX TipRX Ring	3888	Not connected	1338
Line 14	TX TipTX Ring	1565	1439	Not connected
	RX TipRX Ring	3989	Not connected	1439
Line 15	TX TipTX Ring	1666	1540	Not connected
	RX TipRX Ring	4090	Not connected	1540
Line 16	TX TipTX Ring	1767	1641	Not connected
	RX TipRX Ring	4191	Not connected	1641
Line 17	TX TipTX Ring	1868	1742	Not connected
	RX TipRX Ring	4292	Not connected	1742
Line 18	TX TipTX Ring	1969	1843	Not connected
	RX TipRX Ring	4393	Not connected	1843
Line 19	TX TipTX Ring	2070	1944	Not connected
	RX TipRX Ring	4494	Not connected	1944
Line 20	TX TipTX Ring	2171	2045	Not connected
	RX TipRX Ring	4595	Not connected	2045
Line 21	TX TipTX Ring	2272	2146	Not connected
	RX TipRX Ring	4696	Not connected	2146

Subscriber	Connector Pins			
Line 22	TX TipTX Ring	2373	2247	Not connected
	RX TipRX Ring	4797	Not connected	2247
Line 23	TX TipTX Ring	2474	2348	Not connected
	RX TipRX Ring	4898	Not connected	2348
Line 24	TX TipTX Ring	2575	2449	Not connected
	RX TipRX Ring	4999	Not connected	2449

## RJ-45 Cable Pinouts

T1 lines from individual subscribers are attached to the RJ-45 connectors on the front of the 24-port patch panel. Each RJ-45 port accommodates an individual T1 subscriber line.

Pins 1 and 2 and 4 and 5 of the RJ-45 connectors are used for the 24-port CEoP SPA's Transmit (TX) and Receive (RX) signals. Depending on how the cable is installed between the SPA and its patch panel (rear), the RJ-45 connectors operate as follows:

- If the TX cable lead is connected to Transmit on the patch panel and RX is connected to Receive:
  - The SPA's TX signals are transmitted on RJ-45 pins 1 (ring) and 2 (tip).
  - The SPA's RX signals are received on RJ-45 pins 4 (ring) and 5 (tip).
- If the TX cable lead is connected to Receive on the patch panel and RX is connected to Transmit:
  - RJ-45 pins 1 and 2 are used for the SPA's RX signal.
  - RJ-45 pins 4 and 5 are used for the SPA's TX signal.

## Patch Panel Cabling

If you are connecting two 24-Port Channelized T1/E1/J1 CEoP SPAs to each other, you must cable both the SPA's patch panels together using a T1 crossover cable or a T1 straight through cable. The type of cable you use (crossover or straight through) depends on how the CEoP SPAs are cabled to their patch panels:

- If both the CEoP SPAs are connected to their patch panels in the same manner (TX to Transmit and RX to Receive, or TX to Receive and RX to Transmit), use a T1 crossover cable to connect the patch panels to each other.
- If both the CEoP SPAs are connected to their patch panels in a different configuration (TX to Transmit and RX to Receive on one SPA, and TX to Receive and RX to Transmit on the other SPA), use a T1 straight through cable (standard RJ-45 patch cable) between the patch panels.