# Cisco Shared Port Adapters/SPA Interface Processors
# Cisco 1-Port OC-3c/STM-1c ATM SPA, 3-Port OC-3c/STM-1c ATM SPA, and 1-Port OC-12c/STM-4c ATM SPA

The extensible Cisco® I-Flex design combines shared port adapters (SPAs) and SPA interface processors (SIPs), enabling service prioritization for data, voice, and video services. Enterprise and service provider customers can take advantage of improved slot economics resulting from modular port adapters that are interchangeable across Cisco routing platforms. The I-Flex design maximizes connectivity options and offers superior service intelligence through programmable interface processors that deliver line-rate performance.

I-Flex enhances speed-to-service revenue and provides a rich set of quality-of-service (QoS) features for premium service delivery while effectively reducing the overall cost of ownership. This data sheet contains the specifications for the Cisco 1-Port and 3-Port OC-3c/STM-1c ATM, and Cisco 1-Port OC-12c/STM-4c ATM Shared Port Adapters (refer to Figure 1).

**Figure 1.** Cisco 1-Port OC-3 ATM SPA, 3-Port OC-3 ATM SPA, and 1-Port OC-12 ATM SPA

## Product Overview

This data sheet details the features of the new modular ATM SPAs for Cisco XR 12000 Series Routers, the Cisco CRS-1 Carrier Routing System and the Cisco ASR 1000 Series. The Cisco ATM SPAs, in conjunction with other SPAs implementing various types of network technologies, allow the user to flexibly build cost-effective routing solutions focusing on point-of-presence (POP) edge, customer premises equipment (CPE), and enterprise applications.

Designed for all telcos and Internet service providers (ISPs), the Cisco ATM SPAs support a variety of port choices and granularity, including OC-3c/STM-1c and OC-12c/STM-4c interfaces for worldwide use. These modules are designed to support the convergence of data, voice, and video services, allowing customers to migrate existing voice and video traffic onto a corporate data network for substantial cost savings.

The Cisco ATM SPAs include a comprehensive ATM feature set including per-virtual-circuit and per-virtual-path traffic shaping, ATM service classes including constant bit rate (CBR), variable bit rate non-real time (VBR-nrt), variable bit rate real time (VBR-rt), unspecified bit rate (UBR), Multiprotocol Label Switching (MPLS), QoS, a high-performance segmentation-and-reassembly (SAR) architecture, and support for a large number of ATM virtual connections. All these features are based on industry specifications and standards. In conjunction with the SIPs, the Cisco ATM SPAs continue to deliver new features made possible by industry-leading Cisco IOS® Software protocols, services, and an ATM-rich feature set.

The Cisco ATM SPAs address the growing demand for improved ATM QoS features, which are combined with the advanced Layer 3 class-of-service (CoS) capabilities provided by various Cisco routers. Robust QoS mechanisms help prioritize traffic from traditional and high-speed LANs over an ATM network. Network managers can now cost-effectively terminate high-speed ATM, enabling rich QoS features for aggregation or campus applications.

The Cisco ATM SPAs can be inserted in the Cisco SIPs that support various edge services such as:

- IPv4, IPv6, and MPLS hardware-assisted forwarding
- Enhanced security features such as extended access control lists (ACLs), Unicast Return Path Forwarding (URPF), Internet Control Message Protocol (ICMP) rate limiting, and others
- Extensive QoS implementation based on either "classical" QoS (three type-of-service [ToS] bits), Differentiated Services (DiffServ [six DiffServe code point (DSCP) bits]), or MPLS (3 bits EXP)
- Enhanced NetFlow, statistics, and billing data to allow service providers to generate different billing profiles for their customers
- MPLS-VPN support that allows for Layer 3 VPN deployments and various related applications
- Any Transport over MPLS (AtoM) or pseudowire edge-to-edge emulation 3 (PWE3) support for transport solutions

The Cisco ATM SPAs use replaceable Small Form-Factor Pluggable (SFP) optical modules that allow customers the flexibility to use different optical interfaces on the same SPA. The Cisco ATM SPAs are hot-swappable and support service-transparent online insertion and removal (OIR), allowing removal of the SPA without impacting the interface processor and other SPAs.

## Applications

The Cisco ATM SPAs are designed for a wide range of network applications. The specific combination of ATM features and standards makes the Cisco ATM SPAs ideal for both enterprise-based ATM WANs and service provider infrastructures.

### Enterprise-Based ATM WAN

ATM technology is now a favored choice for very high-bandwidth corporate connectivity across an enterprise WAN. Providing connectivity to geographically dispersed facilities, typical ATM WAN interfaces range from 34 to 622 Mbps. These very large WAN “pipes” supply ample bandwidth for the needs of corporate infrastructures today, with room for growth in the future. Enterprise-based ATM WANs can be deployed through private networks or through a public ATM service from large service providers.

With the many advanced ATM capabilities and support for MPLS and QoS (such as per-virtual-circuit and per-virtual-path traffic shaping), the Cisco ATM SPAs are ideal for interconnecting Cisco XR 12000/CRS-1 Carrier Routing System at central sites or larger remote sites through an enterprise-based ATM WAN. The Cisco ASR 1000 Series can be deployed for WAN aggregation of branch offices. Through OC-3c/STM-1c or OC-12c/STM-4c ATM links, the Cisco ATM SPAs can be connected to any standards-based ATM WAN switch, including the Cisco LightStream® 1010, Cisco Catalyst® 8500 Series, Cisco MGX® 8800 Series, Cisco BPX 8600 Series, and Cisco IGX 8400 Series at the switching core.

In the campus backbone or metropolitan-area network (MAN), the OC-12c/STM-4c provides the same scaled-up ATM bandwidth as in the POP when the bandwidth between the ATM switches is increased.

The Cisco ATM SPAs allow you to combine a diverse range of LAN technologies, including Fast Ethernet and Gigabit Ethernet, with ATM in enterprise deployments.

### Service Provider Infrastructures

ATM deployment in service provider infrastructures has seen tremendous growth in recent years as well. This growth has been spurred for several reasons:

- ATM provides highly scalable bandwidth within SONET/SDH infrastructures.
- ATM is inherently a multiservice (data, voice, and video) technology.
- ATM is based on international standards.

The Cisco ATM SPAs provide high-performance interconnectivity for service provider intra-POP applications needing IP transport. Cisco ATM SPAs can also be used for ATM aggregation of remotes sites at the edge of the service provider networks.

Because they support ATM Forum specifications and IETF and ITU standards, the Cisco ATM SPAs can be deployed with any standards-based ATM switch, including the Cisco MGX 8800 Series, Cisco BPX 8600 Series, Cisco IGX 8400 Series, Cisco LightStream 1010, and Cisco Catalyst 8500 Series products.

The Cisco ATM SPAs in conjunction with the Cisco SIPs allow service providers to effectively manage the bandwidth at the edges of the network while implementing value-added Layer 3 services. With advanced traffic-shaping features and support for many ATM service classes, the Cisco ATM SPAs can be widely deployed in many parts of the service provider backbone. Advanced traffic-management features (such as per-virtual-circuit and per-virtual-path traffic shaping) are required to prevent traffic from one customer impacting traffic of another.

### Layer 2 Transport Services

In order to cost-effectively deliver new revenue-generating connectivity options to their customer base, traditional ATM and Frame Relay service providers (telcos, regional Bell operating companies [RBOCs], and incumbent local exchange carriers [ILECs]) are migrating services from cell-based ATM transport networks to packet-based MPLS/IP networks. This migration allows them to deliver the rich functionality of services associated with Layer 3 while gaining the ability to account for, prioritize, and effectively offer these services for profit.

Using the Cisco ATM SPAs in conjunction with the Cisco SIPs, by tunneling core ATM trunks through an MPLS/IP network, you can take advantage of your existing investment in IP networks – networks that are currently low-revenue-generating – and, in essence, enable those networks to mimic and build upon the class-of-service (CoS) abilities of current Frame Relay- and ATM-based networks, all while maintaining continuity of Layer 2 services.

## Features and Benefits

The ATM SPAs offer many advantages, including support for the following features:

- Per-virtual-circuit and per-virtual-path traffic shaping: Traffic shaping is a function typically provided on ATM edge devices to ensure that bursty traffic conforms to a predetermined “contract.” To implement traffic shaping, the Cisco ATM SPAs support per-virtual-circuit and per-virtual-path shaping, including industry-leading minimum 1-kbps granularity, allowing flexibility and control over every virtual circuit and virtual path configured.
- IP QoS and Layer 3 QoS features: The Cisco SIPs and ATM SPAs support per-virtual-circuit IP QoS features that allow you to apply advanced-queuing and bandwidth-management functions, including Low Latency Queuing (LLQ), to individual virtual circuits to avoid congestion and delay. In addition, extended ACLs and committed access rate (CAR) are supported on a per-virtual-circuit basis on both ingress and egress.
- IP/MPLS-to-ATM QoS mapping: Also supported is IP-to-ATM QoS setting through cell-loss priority (CLP) bit support and virtual circuit bundling, which allows you to divide traffic on different virtual circuits, depending on the desired CoS.

- Any Transport over MPLS (AToM): MPLS is the primary technology for ATM/IP convergence, and all the Cisco ATM SPAs allow the transport of Layer 2 traffic across an MPLS network. AToM allows a migration path toward the consolidation of IP and ATM networks while protecting existing equipment investment, and it accommodates the scaling of existing services using MPLS. All ATM operation, administration, and maintenance (OAM) functions are transported.
- Link fragmentation and interleaving (LFI): LFI uses the built-in fragmentation capabilities of Multilink Point-to-Point Protocol (MLPPP) to reduce delay and jitter (variations in delay) caused by variable-sized large packets being queued in between relatively small packets. With LFI, packets larger than a configured fragment size are fragmented and encapsulated in an MLPPP header.

The Cisco SPA/SIP portfolio offers these additional advantages:

- Modular, flexible, intelligent interface processors
  - Superior flexibility, supporting a combination of interface types on the same interface processor for consistent services, independent of access technology.
  - Pioneering programmable interface processors that provide flexibility for the service diversity required in next-generation networks.
  - Innovative design that supports intelligent service delivery without compromising on performance.
- Increased speed-to-service revenue
  - The scalable, programmable Cisco architecture extended to 10 Gbps dramatically improves customer density, increasing potential revenue per platform.
  - Interface breadth (copper, channelized, POS, ATM, and Ethernet) on a modular interface processor allows service providers to roll out new services more quickly, helping ensure that all customers large and small receive consistent, secure, and guaranteed services.
  - High-density SFP interfaces are featured for high-port-count applications with reach flexibility. Future optical technology improvements can be adopted using existing SPAs.
- Dramatically improved return on your routing investment
  - Improved slot economics and increased density reduce capital expenditures (CapEx).
  - The ability to easily add new interfaces as they are needed enables a “pay-as-you-grow” business model while still offering a high-density solution.
  - SPAs are shared across multiple platforms, and can be easily moved from one to another, providing consistent feature support, accelerated product delivery, and a significant reduction in operating expenses (OpEx) through common sparing as service needs change.

## Product Specifications

Table 1 gives specifications of the Cisco ATM SPAs.

**Table 1.** Product Specifications

| Description | Specification |
|---|---|
| Product Compatibility | Cisco XR 12000 Series Routers<br>Cisco ASR 1000 Series Router<br>Cisco CRS Carrier Routing System<br>Cisco 7600 Series Routers<br>Cisco ASR 9000 Series Routers |
| Port Density per SPA | OC-3/STM-1 SPA: 1 and 3 ports<br>OC-12/STM-4 SPA: 1 port |
| Cards/ports/slots | Half-height form factor |

| Description | Specification |
|---|---|
| Physical Interface | SFP optics module (refer to optical parameters in Table 2) |
| LED Indicators | SPA level:<br>• Green: SPA is ready and operational<br>• Amber: SPA power is on and good, but SPA is being configured<br>• Off: SPA power is off<br>Port Level:<br>• Active/Loopback<br>• Green: Port is enabled, loopback is off<br>• Amber: Port is enabled, loopback is on<br>• Off: Port is not enabled<br>Carrier/Alarm<br>• Green: Port is enabled, no SONET alarms<br>• Amber: Port is enabled, at least one SONET alarm is active<br>• Off: Port is not enabled |
| Protocols | • IETF RFC 2684 (updated RFC 1483) support for multiple protocol encapsulations over ATM<br>• IETF RFC 2364 and 2516 for Point-to-Point Protocol (PPP) over ATM<br>• IETF RFC 1577 support for classical IP and Address Resolution Protocol (ARP) over ATM<br>• ATM Forum User-Network Interface (UNI) 3.0, 3.1, and 4.0 |
| ATM/Packet Layer | • Support for up to 2047 virtual circuits per port<br>• Cisco ASR 1000 Series with Cisco IOS XE Release 2.5 and later supports:<br>◦ Up to 4,000 virtual circuits per interface<br>◦ Up to 12,000 virtual circuits per SPA<br>◦ Up to 32,000 virtual circuits per system<br>• Support for up to 8 class-of-service (CoS) queues per virtual circuit, including one Low-Latency Queuing (LLQ) queue per virtual circuit<br>• User-Network Interface (UNI)/Network Node Interface (NNI) cell format-8 UNI virtual-path-identifier (VPI) bits (0-255), 12 NNI VPI bits (0-4000), 16 virtual-channel-identifier (VCI) bits (0–64,000) over any VPI/VCI combination within the full range<br>• Support for up to 255 virtual paths per port<br>• Switched-virtual-circuit (SVC) signaling (point-to-point connections)<br>• SVC signaling (point-to-multipoint connections)<br>• UNI Version 3.0/3.1 (including ILMI)<br>• Multiprotocol Encapsulation over AAL5<br>• Classical IP over ATM; client and Address Resolution Protocol (ARP) server<br>• PWE3 support<br>• ATM permanent virtual circuits (PVCs) and switched virtual circuits (SVCs)<br>• Interim Local Management Interface (ILMI) 1.0<br>• Layer 2 transport and Layer 3 termination on the same port<br>• ATM over MPLS<br>• Per-virtual circuit and per-virtual path statistics |
| Traffic Management | • CBR<br>• VBR-nrt<br>• VBR-rt<br>• UBR<br>• ATM and IP CoS<br>• Per-virtual circuit and per-virtual path traffic shaping<br>• Layer 3 QoS – Class-Based Weighted Fair Queuing (CBWFQ) and LLQ<br>• CLP Bit setting<br>• Hierarchical Shaping<br>• Ingress Classification<br>• Per-virtual circuit Layer 3 queuing |
| Operations, Administration, and Maintenance (OAM) | • OAM<br>F4 and F5 OAM<br>• Alarm indication signal (AIS) and remote defect indication (RDI) alarms and loopback cell |

| Description | Specification |
|---|---|
| SONET Errors, Alarms, and Performance Monitoring | • Signal failure bit error rate (SF-ber)<br>• Signal degrade bit error rate (SD-ber)<br>• Signal label payload construction (C2)<br>• Path trace byte (J1)<br>• Section<br>• Loss of signal (LOS)<br>• Loss of frame (LOF)<br>• Error counts for B1<br>• Threshold crossing alarms (TCA) for B1<br>• Line<br>• Line alarm indication signal (LAIS)<br>• Line remote defect indication (LRDI)<br>• Line remote error indication (LREI)<br>• Error counts for B2<br>• TCA for B2<br>• Path<br>• Path alarm indication signal (PAIS)<br>• Path remote defect indication (PRDI)<br>• Path remote error indication (PREI)<br>• Error counts for B3<br>• TCA for B3<br>• Loss of pointer (LOP)<br>• New pointer events (NEWPTR)<br>• Positive stuffing event (PSE)<br>• Negative stuffing event (NSE)<br>• Path unequipped indication signal (PUNEQ)<br>• Path payload mismatch indication signal (PPLM) |
| SONET Synchronization | • Local (internal) timing (for inter-router connections over dark fiber or wavelength-division multiplexing [WDM] equipment)<br>• Loop (line) timing (for connection to SONET/SDH equipment) |
| Reliability and Availability | • OIR<br>• Field-replaceable SFP optics modules<br>• Support for both 1 + 1 SONET (automatic-protection-switching [APS]) and SDH (multiplex-section-protection [MSP]) protocols<br>• Single SPA software reset |
| MIBS | RFC 2558 MIB (SONET/SDH) |
| Network Management | Simple Network Management Protocol (SNMP) |
| Physical Dimensions (HxWxD) | • Height: 0.8 inches (2.03 cm)<br>• Width: 6.75 inches (17.15 cm)<br>• Depth: 7.28 inches (18.49 cm)<br>• Weight:<br>1-port OC-3/STM-1 ATM SPA:0.95 lbs<br>3-port OC-3/STM-1 ATM SPA:1 lbs<br>1-port OC-12/STM-4 ATM SPA:0.95 lbs |
| Power (Without Optics) | • 1-port OC-3/STM-1 ATM SPA: 14.5W maximum<br>• 3-port OC-3/STM-1 ATM SPA: 18.0.W maximum<br>• 1-port OC-12/STM-4 ATM SPA: 20.5W maximum |

| Description | Specification |
|---|---|
| Approvals and Compliance | CE Marking<br>Safety<br>• UL 60950<br>• CSA 22.2 No.60950<br>• IEC 60950<br>• EN 60950<br>• AS/NZS 3260<br>• TS001<br>EMC<br>• EMC Class A or B conforms with Host System Classification<br>• FCC Part 15 (CFR 47)<br>• ICES 003<br>• EN55022<br>• CISPR 22<br>• AS/NZ CISPR 22<br>• VCCI<br>• EN55024<br>• EN50082-1<br>• EN61000-6-1<br>• EN61000-3-2<br>• EN61000-3-3<br>Telecom<br>• SONET: GR-253 and ANSI T1.105<br>• SDH: ITU G.707, G.783, G.825, and G.957 |
| Environmental Specifications | • Operating temperature: 41 to 104°F (5 to 40°C)<br>• Storage temperature: –38 to 150°F (–40 to 70°C)<br>• Operating humidity: 5 to 85% relative humidity<br>• Storage humidity: 5 to 95% relative humidity |

**Table 2.** Optical Specifications

| Speed | Optics | Maximum Distance |
|---|---|---|
| OC-3/STM-1 | Multimode (MM) short reach (SR) | Up to 1.2 mi (2 km) |
| | Single-mode (SM) SR | Up to 1.2 mi (2 km) |
| | SM intermediate reach (IR-1) | Up to 9 mi (15 km) |
| | SM long reach (LR-1) | Up to 25 mi (40 km) |
| | SM long reach (LR-2) | Up to 50 mi (80 km) |
| OC-12/STM-4 | MM SR | Up to 0.25 mi (500 m) |
| | SM SR | Up to 1.2 mi (2 km) |
| | SM IR-1 | Up to 9 mi (15 km) |
| | SM long reach (LR-1) | Up to 25 mi (40 km) |
| | SM long reach (LR-2) | Up to 50 mi (80 km) |

## Ordering Information

To place an order, visit the Cisco Ordering Home Page. To download software, visit the Cisco Software Center.

**Table 3.** Ordering Information

| Product Name | Part Number |
|---|---|
| Cisco 1-Port OC3c/STM1c ATM Shared Port Adapter | SPA-1XOC3-ATM-V2 |
| Cisco 3-Port OC3c/STM1c ATM Shared Port Adapter | SPA-3XOC3-ATM-V2 |
| Cisco 1-Port OC12c/STM4c ATM Shared Port Adapter | SPA-1XOC12-ATM-V2 |
| OC-3/STM-1 SFP, MM, SR | SFP-OC3-MM |
| OC-3/STM-1 SFP, SM, SR | SFP-OC3-SR |
| OC-3/STM-1 SFP, SM, IR-1 | SFP-OC3-IR1 |
| OC-3/STM-1 SFP, SM, LR-1 | SFP-OC3-LR1 |
| OC-3/STM-1 SFP, SM, LR-2 | SFP-OC3-LR2 |
| OC-12/STM-4 SFP, MM, SR | SFP-OC12-MM |
| OC-12/STM-4 SFP, SM, SR | SFP-OC12-SR |
| OC-12/STM-4 SFP, SM, IR-1 | SFP-OC12-IR1 |
| OC-12/STM-4 SFP, SM, LR-1 | SFP-OC12-LR1 |
| OC-12/STM-4 SFP, SM, LR-2 | SFP-OC12-LR2 |

## Service and Support

Using the Cisco Lifecycle Services approach, Cisco and its partners provide a broad portfolio of end-to-end services and support that can help increase your network's business value and return on investment. This approach defines the minimum set of activities needed, by technology and by network complexity, to help you successfully deploy and operate Cisco technologies and optimize their performance throughout the lifecycle of your network.

## For More Information

For more information about the Cisco SPA/SIP portfolio, visit http://www.cisco.com/go/spa or contact your local Cisco account representative.

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.



Printed in USA C78-487941-05 12/11