

# Overview of Cisco uBR10012 Router Shared Port Adapters

This chapter describes the shared port adapters (SPAs) that are supported on the Cisco uBR10012 router and contains the following sections:

- [SPA Summary, page 3-1](#)
- [Bandwidth Oversubscription, page 3-2](#)
- [Cisco Wideband SPA Overview, page 3-2](#)
- [1-Port 10-Gigabit Ethernet SPA Overview, page 3-5](#)
- [5-Port Gigabit Ethernet SPA Overview, page 3-8](#)

## SPA Summary

Summary descriptions of the SPAs that are supported on the Cisco uBR10012 router are shown in [Table 3-1](#).

**Table 3-1 SPA Summary**

| SPA   | Product Number  | Number of Ports | Minimum Cisco IOS Release   |
|---|-----------------|-----------------|---|
| Cisco Wideband SPA  | SPA-24XDS-SFP   | 2               | 12.3(21)BC  |
| 5-Port Gigabit Ethernet SPA   | SPA-5X1GE-V2    | 5               | 12.2(33)SCB<br><b>Note</b> We recommend that you use any two of the five ports with a PRE2 setup. |
| 1-Port 10-Gigabit Ethernet SPA (supported only with PRE4 configuration) | SPA-1X10GE-L-V2 | 1               | 12.2(33)SCB   |

## Bandwidth Oversubscription

Oversubscribing the bandwidth limit recommendations of a router can result in decreased or degraded performance. For this reason, it is important to determine the amount of bandwidth used by the SPAs on the router and verify that the total bandwidth used by all SPAs does not exceed the recommended bandwidth limit of the router. It is also important not to exceed the bandwidth of the SIP. For information on SIP bandwidth, see the “[SIP Summary](#)” section on page 2-1.

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

**Table 3-2 SPA Bandwidth Capacity**

| SPA                             | Per-Port Bandwidth | Number of Ports | Total Bandwidth      |
|---------------------------------|--------------------|-----------------|----------------------|
| Cisco Wideband SPA <sup>1</sup> | 1 Gbps             | 1+1 redundant   | 1 Gbps (egress only) |
| 5-Port Gigabit Ethernet SPA     | 1 Gbps             | 5               | 5 Gbps               |
| 1-Port 10-Gigabit Ethernet SPA  | 10 Gbps            | 1               | 10 Gbps              |

1. The Cisco uBR10012 router supports up to six Cisco Wideband SPAs.

## Cisco Wideband SPA Overview

The Cisco Wideband SPA is a single-wide, half-height shared port adapter that provides Cisco Wideband Protocol for a DOCSIS network formatting to the downstream data packets. The Cisco Wideband SPA is used for downstream data traffic only.

The Cisco Wideband SPA has one active and one redundant Gigabit Ethernet port that is used to send traffic to the external edge QAM device. If the link state of both Gigabit Ethernet ports is up, port 0 will come up as the active port and port 1 will be the redundant port. If the link state of port 0 is not up, port 1 will come up as the active port.

The Cisco uBR10012 router can support up to six Cisco Wideband SPAs. Depending on how it is configured, each Cisco Wideband SPA supports up to 24 RF channels. Each Cisco Wideband SPA can support up to 32 logical wideband channels (bonding groups).

The Cisco Wideband SPA contains field-programmable devices: the Cisco Wideband SPA FPGAs and Complex Programmable Logic Device (CPLDs). The FPGA and CPLD upgrade information is part of the Cisco IOS release rather than a separate file to be downloaded by users. For more information on Cisco Wideband SPA image upgrades, see the “[Cisco Wideband SIP and SPA PLD Configuration Image Upgrades](#)” section on page 6-5.

The following sections describe the Cisco Wideband SPA:

- [Cisco Wideband SPA LEDs, page 3-3](#)
- [SFP Modules for the Cisco Wideband SPA, page 3-3](#)
- [SFP Module Cables and Connectors, page 3-4](#)

## Cisco Wideband SPA LEDs

The Cisco Wideband SPA has two types of LEDs (Figure 3-1):

- Port Status LED (labeled A/L) for each Gigabit Ethernet SFP port
- Board Status LED (labeled STATUS) for the entire SPA

**Figure 3-1** Cisco Wideband SPA Faceplate



Table 3-3 describes the Cisco Wideband SPA LEDs.

**Table 3-3** Cisco Wideband SPA LEDs

| LED Label             | Color              | State | Meaning  |
|-----------------------|--------------------|-------|--|
| A/L (Active/<br>Link) | Off                | Off   | Port is not enabled.                                   |
|                       | Amber              | On    | The port is enabled and the link is down.              |
|                       | Green              | On    | The port is enabled and the link is up.                |
| STATUS                | Off                | Off   | SPA power is off.                                      |
|                       | Amber <sup>1</sup> | On    | SPA power is on and good, and SPA is being configured. |
|                       | Green              | On    | SPA is ready and operational.                          |

1. The STATUS LED blinks amber when the Cisco Wideband SPA FPGA or CPLD images are being reprogrammed.

## SFP Modules for the Cisco Wideband SPA

The small form-factor pluggable (SFP) modules are input/output (I/O) devices that plug into the Gigabit Ethernet ports on the Cisco Wideband SPA, linking the port with an edge QAM device through a fiber-optic network.

You can use any SFP modules that the Cisco Wideband SPA supports. See Table 3-4 for SFP modules that are supported. The only restrictions are that each SFP module must match the wavelength specifications on the other end of the cable and that the cable must meet the stipulated cable length range for reliable communications.

**Table 3-4** SFP Modules for the Cisco Wideband SPA

| SFP Module Product Number | SFP Module                           | Description   |
|---------------------------|--------------------------------------|---|
| SFP-GE-T                  | 1000BASE-T-SFP pluggable transceiver | Cisco 1000BASE-T SFP, pluggable transceiver module, 100-m on Category 5 (Cat5), Category 5e (Cat 5e), Category 6 (Cat 6) cable. |
| GLC-SX-MM                 | Short wavelength (1000BASE-SX)       | Cisco 1000BASE-SX SFP transceiver module for multimode fiber (MMF), 850-nm wavelength   |

**Table 3-4 SFP Modules for the Cisco Wideband SPA**

| SFP Module Product Number | SFP Module                                 | Description   |
|---------------------------|--|---|
| GLC-LH-SM                 | Long wavelength/long haul (1000BASE-LX/LH) | Cisco 1000BASE-LX/LH SFP transceiver module for single-mode fiber (SMF), 1300-nm wavelength |
| GLC-ZX-SM                 | Extended distance (1000BASE-ZX)            | Cisco 1000BASE-ZX SFP transceiver module for SMF, 1550-nm wavelength                        |

Use only Cisco SFP transceiver modules on your Cisco device. Each SFP transceiver module has an internal serial EEPROM that is encoded with security information. This encoding allows Cisco to identify and validate that the SFP transceiver module meets the requirements for the device.

## SFP Module Cables and Connectors

The SFP transceiver modules are hot-pluggable I/O devices that plug into Cisco Wideband SPA ports. The transceiver connects the electrical circuitry of the module with the optical network. An SFP transceiver module is shown in [Figure 3-2](#).

**Figure 3-2 SFP Transceiver Module (Fiber-Optic LC Connector)**

SFP modules provide duplex single-mode and multimode connections in supported devices. [Table 3-5](#) lists the cable specifications for fiber-optic SFP module ports.

**Table 3-5** *Fiber-Optic SFP Transceiver Module Cabling Specifications*

| SFP Module Model Speed        | Wavelength (nanometers) | Fiber Type       | Core Size (micron) | Modal Bandwidth (MHz/km) | Cable Distance                  |
|-------------------------------|-------------------------|------------------|--------------------|--------------------------|---------------------------------|
| GLC-SX-MM<br>(1000BASE-SX)    | 850                     | MMF              | 62.5               | 160                      | 722 feet (220 m)                |
|                               |                         |                  | 62.5               | 200                      | 902 feet (275 m)                |
|                               |                         |                  | 50.0               | 400                      | 1640 feet (500 m)               |
|                               |                         |                  | 50.0               | 500                      | 1804 feet (550 m)               |
| GLC-LH-SM<br>(1000BASE-LX/LH) | 1300                    | MMF <sup>1</sup> | 62.5               | 500                      | 1804 feet (550 m)               |
|                               |                         |                  | 50.0               | 400                      | 1804 feet (550 m)               |
|                               |                         |                  | 50.0               | 500                      | 1804 feet (550 m)               |
|                               |                         | SMF              | G.652              | —                        | 32,810 feet (10 km)             |
| GLC-ZX-SM<br>(1000BASE-ZX)    | 1550                    | SMF              | G.652              | —                        | 43.4 to 62 miles (70 to 100 km) |

1. A mode-conditioning patch cord is required at all times per IEEE specifications.

**Note**

For the GLC-ZX-SM, the minimum attenuation between the transmit bore (TX) and the receive bore (RX) is 8 dB. When using shorter distances of single-mode fiber cable, you might need to insert an inline optical attenuator in the link to avoid overloading the receiver.

## 1-Port 10-Gigabit Ethernet SPA Overview

The following sections describe the :

- [1-Port 10-Gigabit Ethernet SPA LEDs, page 3-5](#)
- [1-Port 10-Gigabit Ethernet SPA XFP Optical Transceiver Modules, Connectors, and Cables, page 3-6](#)

### LEDs

The has two LEDs, an ACTIVE/LINK LED for the port and a STATUS LED, as shown in [Figure 3-3](#).

**Figure 3-3** *Faceplate*

|          |                 |          |            |
|----------|-----------------|----------|------------|
| <b>1</b> | ACTIVE/LINK LED | <b>2</b> | STATUS LED |
|----------|-----------------|----------|------------|

Table 3-6 describes the LEDs.

**Table 3-6 LEDs**

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

## XFP Optical Transceiver Modules, Connectors, and Cables

The SPA supports the following types of optical transceiver modules:

- 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 (ZR) XFP module—XFP-10GER-OC192LR

Cisco qualifies the optics that are approved for use with its SPA. The above-listed small form-factor pluggable modules (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.



**Note**

The 40-pin connector on the SPA is used for resilient packet ring (RPR) connections.

## XFP Connections

The XFP-10GLR-OC192SR, XFP-10GER-OC192IR, and XFP-10GER-OC192LR modules include an optical transmitter and receiver pair integrated with Clock and Data Recovery (CDR) integrated circuits. The XFP modules provide high-speed serial links at the rate of 10.3125 Gbps (10 Gigabit Ethernet) on single-mode fiber (SMF). The transmit side recovers and retimes the 10-Gbps serial data and passes it to a laser driver. The laser driver biases and modulates a 1310-nm or 155-nm laser, enabling data transmission over SMF through an LC connector. The receive side recovers and retimes the 10-Gbps optical data stream from a photo detector transimpedance amplifier and passes it to an output driver.

See the label on the XFP module for technology type and model. Figure 3-4 shows an XFP module and Table 3-7 shows the XFP module specifications.

**Figure 3-4 XFP Module**

XFP module dimensions are:

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

**Table 3-7 XFP Module Specifications for 1-Port 10-Gigabit Ethernet SPA**

| Specification                    | Description   |
|----------------------------------|---|
| Wavelength (TX)                  | 10GLR SR-1: 1260 nm to 1355 nm<br>10GER IR-2: 1530 nm to 1565 nm<br>10GZR LR-2: 1530 nm to 1565 nm  |
| Cabling distance (maximum)       | 10GLR SR-1: 6.2 miles (10 km)<br>10GER IR-2: 24.8 miles (40 km)<br>10GZR LR-2: 50 miles (80 km)   |
| Operating case temperature range | 10GLR SR-1: 23 to 158 degrees F (–5 to 70° C)<br>10GER IR-2: 23 to 158 degrees F (–5 to 70° C)<br>10GZR LR-2: 23 to 158 degrees F (–5 to 70° C)       |
| Storage temperature range        | 10GLR SR-1: –40 to 185 degrees F (–40 to 85° C)<br>10GER IR-2: –40 to 185 degrees F (–40 to 85° C)<br>10GZR LR-2: –40 to 185 degrees F (–40 to 85° C) |
| TX power                         | 10GLR SR-1: –8.2 to 0.5 dBm<br>10GER IR-2: –4.7 to 4 dBm<br>10GZR LR-2: 0 to 4 dBm  |
| Receiver sensitivity (maximum)   | 10GLR SR-1: –12.6 dBm<br>10GER IR-2: –14.1 dBm<br>10GZR LR-2: –24 dBm   |
| RX overload                      | 10GLR SR-1: 0.5 dBm<br>10GER IR-2: –1.0 dBm<br>10GZR LR-2: –7.0 dBm   |
| Maximum receiver power damage    | 10GLR SR-1: 5 dBm<br>10GER IR-2: 5 dBm<br>10GZR LR-2: 5 dBm   |

## XFP Port Cabling Specifications

Table 3-8 shows the port cabling specifications for an XFP module.

**Table 3-8 XFP Port Cabling Specifications**

| XFP Module        | Wavelength | Fiber Type |
|-------------------|------------|------------|
| XFP-10GLR-OC192SR | 1310 nm    | SMF        |
| XFP-10GER-OC192IR | 1550 nm    | SMF        |
| XFP-10GZR-OC192LR | 1550 nm    | SMF        |

## 5-Port Gigabit Ethernet SPA Overview

The following sections describe the :

- [5-Port Gigabit Ethernet SPA LEDs, page 3-8](#)
- [5-Port Gigabit Ethernet SPA Cables and Connectors, page 3-9](#)

## 5-Port Gigabit Ethernet SPA LEDs

The has two types of LEDs: an A/L LED for each individual port and a STATUS LED for the SPA, as shown in [Figure 3-5](#).

**Figure 3-5 Faceplate**



|          |                       |          |            |
|----------|-----------------------|----------|------------|
| <b>1</b> | A/L (Active/Link) LED | <b>2</b> | STATUS LED |
|----------|-----------------------|----------|------------|

Table 3-9 describes the LEDs.

**Table 3-9 LEDs**

| LED Label | Color | State | Meaning                               |
|-----------|-------|-------|---------------------------------------|
| A/L       | Off   | Off   | Port is not enabled.                  |
|           | Green | On    | Port is enabled and the link is up.   |
|           | Amber | On    | Port is enabled and the link is down. |
| STATUS    | Off   | Off   | SPA power is off.                     |

**Table 3-9 LEDs**

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

## 5-Port Gigabit Ethernet SPA Cables and Connectors

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

### SFP Module Connections

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



#### Note

The accepts only the SFP modules listed as supported in this document. An SFP module check is run every time an SFP module is inserted into the , and only SFP modules that pass this check can be used by the .

SFP modules exist for technologies other than Gigabit Ethernet and for products other than the . However, the information in this document pertains only to SFP modules that plug into the ports.

The SFP module has a receiver port (RX) and a transmitter port (TX) that compose one optical interface. [Table 3-10](#) and [Table 3-11](#) provide SFP module information and specifications.

**Table 3-10 SFP Module Options**

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

**Table 3-11 SFP Module Specifications**

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

**SFP-GE-S Modules**

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

**SFP-GE-L Modules**

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

**SFP-GE-Z Modules**

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

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

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

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

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

## SFP-GE-T Modules

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

## SFP Module Cabling and Connection Equipment

Table 3-12 provides cabling specifications for the SFP modules that can be installed on the . Note that all SFP ports have LC-type connectors.

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

**Table 3-12 SFP Module Port Cabling Specifications**

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

1. Multimode fiber (MMF) only.

2. A mode-conditioning patch cord is required.

When using the SFP-GE-L with 62.5-micron diameter MMF, you must install a mode-conditioning patch cord between the SFP module and the MMF cable on both the transmit and the receive ends of the link when link distances are greater than 984 ft (300 m).

We do not recommend using the SFP-GE-L and MMF with no patch cord for very short link distance (tens of meters). The result could be an elevated bit error rate (BER).

3. Dispersion-shifted single-mode fiber-optic cable.

**Note**

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

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